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Comment

NASA's historic B-52 mothership lifts the X-43A and its Pegasus booster rocket on a captive carry flight from Edwards Air Force Base, California, in 2004. The hydrogen-fuelled vehicle provides one possible indication of what a future USAF hypersonic cruise missile may look like. *NASA/Carla Thomas*

The USAF's missile drive

The US Air Force is making swift progress towards fielding a new-generation cruise missile for Air Force Global Strike Command's manned bomber fleet.

On April 17, the flying branch selected Raytheon Technologies as sole-source contractor for its US$4.54bn Long-Range Standoff (LRSO) weapon. In a press release, the air force described the LRSO cruise missile as "a critical element of [its] ongoing nuclear recapitalisation efforts."

Wes Kremer, president of Raytheon Missiles & Defense, added: "LRSO will be a critical contributor to the air-launched portion of America's nuclear triad. Providing a modernised capability to the US Air Force will strengthen our nation's deterrence posture."

The USAF settled on the Raytheon design after awarding US$900m-worth of contracts for the Technology Maturation and Risk (TMRR) phase to both Raytheon and Lockheed Martin in August 2017. Maj Gen Shaun Morris, Air Force Nuclear Weapons Center (AFNWC) commander and programme executive officer for strategic systems, noted that the Raytheon proposal represented a "high-confidence design."

The LRSO will replace the nuclear-tipped AGM-86B cruise missile, which is carried exclusively by the B-52H, and the new weapon will also outfit the forthcoming B-21 bomber and is additionally earmarked for the B-2A.

Coupled with news this month of Russian progress in the resumption of Tu-160 *Blackjack* production (see p6), and the return to service of modestly upgraded Tu-160M1s (see p20), it seems the strategic bomber is still very much in vogue – in the US and Russia, at least. But as Air Marshal (ret'd) Greg Bagwell CB CBE argues in his latest column (see p62), it's increasingly the *weapon* and not the aircraft that's the dominant factor.

While the LRSO will likely represent an evolutionary design approach, the USAF is also looking even further ahead to an air-launched hypersonic cruise missile, this time with a conventional warhead. Activity kicked off on April 28 with a sources-sought notice on the US government's procurement website. Contenders are likely to include Lockheed Martin and Raytheon again, both of which are developing demonstrators under the Hypersonic Air-breathing Weapon Concept (HAWC). However, Boeing also has experience in the field, with its scramjet-powered X-43 and X-51 vehicles. The air force envisages a solid-rocket boosted missile with an air-breathing propulsion system in the second stage.

The Pentagon is confident such technology is now within reach, and with a preliminary design review planned within 18 months, we may soon see the results.

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***Cover:** Anthony Pecchi's extraordinary capture of an Uzbek Air Force Su-25 'Frogfoot' loosing off a salvo of S-24 heavy unguided rockets against a ground target. For this issue, AFM was granted unique access to the various bases of the rarely photographed Central Asian air arm, which remains one of the least-known among all the former Soviet Republics.* Anthony Pecchi
***Above:** A low-level training flight for HH-101A MM81867 '15-04' of the 15° Stormo, somewhere over central Italy: during daylight this is the best tactic to remain hidden from enemy radar and safely approach the target. Turn to p40 for the full story of the Italian Air Force's powerful new Caesar combat search and rescue helicopters.* Mauro Finati

Latest Baltic Air Policing rotation under way

Above: RAF Typhoon FGR4 ZK320 '320' from No 6 Squadron departs Lossiemouth for Operation Azotize. *Crown Copyright*

FOUR EF-18M Hornets from the Ejército del Aire's (Spanish Air Force's) Ala 15, based at Zaragoza, assumed the lead role in the latest Baltic Air Policing (BAP) mission at Šiauliai air base in Lithuania on May 1. The Spanish detachment is being augmented by RAF Typhoon FGR4s from No 6 Squadron, based at RAF Lossiemouth, Scotland, also deployed to Šiauliai. Further support is being provided by four Mirage 2000-5Fs from the Armée de l'Air's (French Air Force's) Groupe de Chasse 1/2 'Cigognes' from Luxeuil, which are at Ämari air base in neighbouring Estonia. The three nations will police Estonian, Latvian and Lithuanian airspace until the end of August.

The RAF contingent departed Lossiemouth on April 28 under Operation Azotize, with the No 6 Squadron detachment supplemented by individuals from across the service to form 135 Expeditionary Air Wing, consisting of around 150 personnel. It is the sixth time the RAF has participated in the BAP mission, having previously deployed to the region in 2004, 2014, 2015, 2016 and 2019.

Wg Cdr Matt D'Aubyn, the officer commanding No 6 Squadron, said: "The NATO Air Policing mission in the Baltics is very similar to the UK [quick reaction alert], and my pilots and supporting personnel are experienced operators when it comes to completing this sort of task. Despite the difficult circumstances caused by COVID-19 we are well prepared and ready to deliver this mission."

The latest rotation replaces detachments from Belgium and Poland, which together defended the airspace of the Baltic States since January.

First new Tu-160 in production

Above: ***A still from the Rossiya24 broadcast showing new-build Tu-160M production under way at the Kazan plant.*** *Rossiya24*

RUSSIAN STATE television broadcast a report from the Gorbunov Kazan Aircraft Plant on April 17, as the facility returned to work after a two-week break due to the coronavirus. It was announced that the factory was "working now in three shifts" and continuing construction of the first Tu-160M strategic bomber. A factory representative said that "aggregates are currently being assembled and the airframe is being constructed." The footage showed an almost-complete F-4 fuselage section (the wing centre section) and the tail part, on which work was less advanced.

The decision to resume series production of the Tu-160 was made in early 2015 and was disclosed in public by Russia's defence minister, Sergei Shoygu, on April 29 that year, during his visit to Kazan. Deputy Prime Minister Yuri Borisov explained later that resurrecting the Tu-160 reflected a decision "to take a less risky path." He added: "At the same time, we have postponed the next-generation PAK DA bomber, to gain experience and restore technology," while the modernised Tu-160M "will suit the armed forces until [the] 2050s or even 2060s".

The defence ministry inked an order for the first ten new Tu-160s in Kazan on January 25, 2018, in the presence of President Vladimir Putin, with a value of 15 billion roubles (almost US$270m at the then exchange rate) per aircraft. While new production involves a modernised Tu-160M version, the same improvements are being introduced to the current operational aircraft. Initially, the newly produced aircraft were to be designated Tu-160M2, in contrast with the Tu-160M mid-life upgrades. Now the designations have been unified and both new bomber and upgraded aircraft will be designated Tu-160M.

The television report confirmed that the first aircraft will be ready next year. It also stated that the Kazan plant is simultaneously upgrading 30 Tu-22M3M medium bombers. **Piotr Butowski**

Initial Gripen F in production

SAAB ANNOUNCED on March 26 that it has cut the first metal for the initial Gripen F, the two-seat version of the Gripen E fighter that is under development for the Força Aérea Brasileira (FAB, Brazilian Air Force). While the JAS 39F shares much of its design with the single-seater, it adds a seat, displays and controls for a second crew member. The aircraft will offer a training mode for tuition of one crew member and another in which two pilots can share mission workload with different display settings.

The first component was manufactured at Saab's facilities in Linköping and is for the air duct section, just behind the cockpit.

Brazil has ordered 28 Gripen Es, which will be delivered to the country starting next year, and eight Gripen Fs, which will be handed over from 2023. The Gripen F is also being offered to Finland for its fighter replacement programme.

Eielson AFB welcomes F-35A

Three F-16C/Ds and two F-35As from the 354th FW move into position to fly in formation off a KC-135R from the 168th Wing, Alaska Air National Guard, also based at Eielson, over the Alaska Range on April 21. *USAF/Tech Sgt Adam Keele*

THE FIRST two F-35As for Eielson Air Force Base arrived at the installation on April 21.

With the receipt of the Lightning IIs, the Alaskan base is the first within Pacific Air Forces (PACAF) to house the fifth-generation fighter.

A total of 54 F-35As will be handed over to Eielson's 354th Fighter Wing (FW) by December next year. The constituent 356th Fighter Squadron (FS) was reactivated in October 2019 and the first jet for the unit – serial 18-5345 'AK/354 OG' – took to the air on March 10 (see *First F-35A for Alaska Air National Guard*, May, p16)

Col Benjamin Bishop, the 354th FW commander, said: "When you station the F-35 at Eielson and you have the F-22 Raptor down at Joint Base Elmendorf-Richardson, working together in the Joint Pacific Alaska Range Complex with our 18th Aggressor Squadron and ground training assets, you have the perfect training field for the F-35 to develop."

Germany earmarks more Eurofighters plus F/A-18E/F and EA-18G

Above: ***Seen recently at Nörvenich air base, Luftwaffe Eurofighter 31+49 (GS0109) received these special Quadriga/Tranche 4 markings ahead of its planned appearance at the now-cancelled ILA Berlin airshow.*** *Markus Altmann*

THE GERMAN defence ministry has confirmed its intent to purchase 30 F/A-18E/Fs adapted to carry B61-12 freefall nuclear bombs, plus 15 EA-18G electronic attack aircraft to replace the Luftwaffe's current inventory of Tornado IDS/ECR aircraft.

The last Tornados are due for withdrawal by 2030 and the Boeing-made jets have been selected as a 'bridging solution' pending availability of the pan-European New Generation Fighter being developed under the Future Combat Air System (FCAS) programme for service from around 2040.

Defence minister Annegret Kramp-Karrenbauer officially informed Washington of the decision on April 16.

At the same time, the ministry plans a separate purchase of 93 additional Tranche 4 Eurofighters. These will comprise 38 EF2000s acquired under the Quadriga programme to replace the Luftwaffe's early Tranche 1 aircraft, plus another 55 jets to succeed a portion of the Tornado fleet, 85 examples of which are scheduled for replacement. The ministry hopes to launch procurement of the new aircraft in 2025.

The final decision on funding the purchases rests with the Bundestag, Germany's federal parliament, where it will likely face opposition from the socialist SPD party.

Boeing

First flight for F-15QA

THE INITIAL F-15QA (Qatar Advanced) completed its maiden flight on April 13 in the hands of Boeing's chief test pilot, Matt Giese. Described by the manufacturer as the most advanced version of the F-15 ever manufactured, the jet demonstrated its capabilities during a 90-minute mission from Lambert International Airport in St Louis, Missouri.

The aircraft performed a vertical 'Viking' take-off, then pulled 9G during subsequent manoeuvring. Successful checks of systems including avionics and radar also took place.

The US Department of Defense awarded Boeing a US$6.2bn contract in 2017 to manufacture 36 F-15QA jets for the Qatar Emiri Air Force (QEAF). Deliveries are planned to begin next year. In addition, Boeing received a USAF Foreign Military Sales contract last year for F-15QA aircrew and maintenance training for the QEAF.

SkyGuardian flight paves way for UK's Protector

THE INITIAL production-representative MQ-9B SkyGuardian remotely piloted aircraft (RPA) has completed its maiden flight. The aircraft, line number BC03, took to the air at General Atomics Aeronautical Systems' (GA-ASI's) Flight Operations Facility in El Mirage, California, on March 30.

Aircraft BC03 will be used for ground and flight testing to collect airworthiness certification data, with a focus on flight loads and aircraft performance. Results from these trials will form the Type Certification Exposition required to achieve the Military Type Certificate for the RAF's Protector RG1 platform – the UK's configuration of the SkyGuardian.

The next aircraft, BC04 (also known as UK1), is now in production and will be the first Protector delivered to the RAF. Prior to handover to the air arm, BC04 will be used for combined system tests and weapons trials.

Gp Capt Shaun Gee, Protector RG1 programme director, said: "As the lead customer, we are tracking all of the important developments of this ground-breaking, remotely piloted aircraft. The Military Type Certificate is a particularly important milestone because it's a foundational step towards the Protector RPA being approved to fly in unsegregated airspace."

The UK is committed to acquiring an initial 16 Protector RG1s to replace the existing Reaper fleet; they will serve with No 31 Squadron at RAF Waddington, Lincolnshire and a first example is planned to be delivered in October 2021.

MQ-9B SkyGuardian BC03 outside its hangar at GA-ASI's Flight Operations Facility in El Mirage, California. *GA-ASI*

Merlin HM2 Crowsnest trials continue

ROYAL NAVY Merlin HM2 ZH831 was noted with further Crowsnest-related modifications during a test flight on April 9, using the callsign 'WHE05'. As well as the air-data probe below the nose, the helicopter now appears to feature a strain gauge on one of the rotor blades (denoted by high-visibility panels) to determine the loading impact of carrying the radar offset to one side.

This aircraft was the first to be fitted with the Crowsnest system, and began test flying last year. Crowsnest is intended to achieve initial operational capability later this year, replacing the now-retired Sea King ASaC7.

Stu Weston

H145 for QinetiQ under test in Germany

Future QinetiQ H145 c/n 20322 at Donauwörth on April 23. While social distancing in the cockpit is impossible, it's noteworthy that the aircraft's crew are flying with protective masks. *A Pfister*

DESPITE THE COVID-19 lockdown in Germany, there is still some flying activity at the Airbus Helicopters factory in Donauwörth, Bavaria. A new H145 for QinetiQ is now flying after assembly at the facility and is expected to be delivered soon. The helicopter, c/n 20322, currently wears the German civil test registration D-HADY.

As part of an overhaul of its fleet, QinetiQ has introduced four H125s, two Grob G 120TP-As and two PC-21s, but an order for the H145 had not previously been announced.

British Army Air Corps forms 1st Aviation Brigade

A NEW Army Air Corps (AAC) unit, the 1st Aviation Brigade, has been formed to bring together all the elements of the attack and reconnaissance helicopter force as a deployable combat aviation brigade. The unit was formally established on April 1, although the British Army made no official announcement regarding its formation. However, AVM Nigel Colman, commander of Joint Helicopter Command, confirmed that it had come into being on his Twitter account on the same day. This deployable and scalable army aviation command and control asset immediately began operations in the UK in support of the COVID Support Force.

The new brigade takes over control of the Attack Helicopter Force (AHF) and the Aviation Reconnaissance Force (ARF). The AHF, based at Wattisham Flying Station, Suffolk, comprises 3 Regiment (653, 662 and 663 Squadrons) and 4 Regiment (656 and 664 Squadrons), all equipped with the Apache AH1, while the ARF encompasses 1 Regiment (652, 659 and 661 Squadrons) with the Wildcat AH1 at Royal Naval Air Station, Yeovilton, Somerset, together with 5 Regiment/665 Squadron with Gazelle AH1s at Joint Helicopter Command Flying Station Aldergrove, Northern Ireland, plus British Army Training Unit Suffield's (BATUS') 29 (BATUS) Flight at Canadian Forces Base Suffield, Alberta, Canada, also with the Gazelle AH1.

The brigade will begin upgrading its rotary-wing assets at the end of this year, when the first AH-64E variant of the Apache will be delivered to 3 Regiment. The unit expects to be up and running with the type by mid-2021. **Dave Allport**

Cosford receives five retired Hawks

FIVE RETIRED RAF Hawk T1/T1A/T1W trainers have recently been delivered to RAF Cosford, Shropshire, for the Defence School of Aeronautical Engineering's No 1 School of Technical Training (No 1 S of TT) to use as ground instructional airframes. All were previously stored with the Aircraft Maintenance and Storage Unit (AM&SU) at RAF Shawbury, Shropshire, where they were dismantled before the Joint Aircraft Recovery and Transportation Squadron (JARTS) moved them by road to Cosford.

First to arrive was ex-Red Arrows T1A XX227 on February 25, followed the next day by T1W XX178, still in full No 208 (Reserve) Squadron markings. The next deliveries, both on March 3, were T1 XX168 and T1W XX283. The fifth and final aircraft, T1A XX218, again in No 208(R) Squadron colours, arrived on March 10. With all five now reassembled and safely moved into one of the No 1 S of TT hangars, work has begun to prepare them for use in training apprentices.

Another Hawk previously stored at Shawbury, T1W XX236, had been delivered to No 1 S of TT at Cosford on March 19 last year, to act as a trials aircraft to determine the suitability of the type for ground training of aircraft apprentices.

Two other Hawks that had been in storage with AM&SU Shawbury, T1 XX173 and ex-Royal Navy/736 Naval Air Squadron T1A XX240, have been allocated to JARTS for ground training. Of these, XX240 is at Cornwall Airport Newquay, Cornwall, where it will now be put on display at the Cornwall Aviation Heritage Centre when not being used for JARTS exercises at its facility there. The fuselage of the other, XX173, will reportedly be used by JARTS for destructive testing and training. **Dave Allport**

Above: ***The fuselage of ex-No 208 (Reserve) Squadron Hawk T1W XX283, still carrying full unit markings, arriving at RAF Cosford on March 3 from RAF Shawbury to join No 1 S of TT as a ground instructional airframe.*** *MOD Crown Copyright/RAF Cosford*

UK hones Attack Reconnaissance Teaming on Clockwork

THE ROYAL Navy's Commando Helicopter Force (CHF) has taken part in Exercise Clockwork in the Norwegian Arctic. During the 51st iteration of the extreme cold weather flying training earlier this year, Wildcat AH1s of 847 Naval Air Squadron (NAS) from Royal Naval Air Station Yeovilton, Somerset, continued their work with Apache AH1 attack helicopters of 656 Squadron Army Air Corps from Wattisham Flying Station, Suffolk.

Maj Ian Moore RM, commander of 847 NAS, explained: "A particular highlight has been the rapid development of the Attack Reconnaissance Teaming concept, which has seen Apache and Wildcat learn how to exploit and maximise their respective capabilities, and then work together to multiply the find and strike effect for the primary customer, in this case 3 Commando Brigade."

The training included the Apache firing Hellfire missiles for the first time in the Arctic, as well as using its 30mm cannon. Meanwhile, the Wildcats employed their 0.5in calibre machine guns during live-fire training at Setermoen Ranges, working with ground forces from the US Marine Corps and Norway.

After completing the Clockwork training, the CHF fliers progressed to the Norwegian-led Exercise Cold Response, again involving the Wildcat and Apache, while Merlin HC4s of 845 NAS – also from RNAS Yeovilton – embarked in the Dutch amphibious assault ship HNLMS *Johan De Witt*. From there, the Merlins flew inland in support of 45 Commando's Battle Group on fjord raids, backed by Wildcats and Apaches.

A Wildcat AH1 from 847 NAS providing overwatch for the Cold Response Task Group off the Norwegian coast last March. *Crown Copyright*

Commando Merlin in the Caribbean

THREE MERLIN HC4 helicopters from the Royal Navy's 845 Naval Air Squadron (NAS), part of the Commando Helicopter Force at Royal Naval Air Station Yeovilton, Somerset, have deployed to the Caribbean on board RFA *Argus*. The vessel departed HM Naval Base Devonport for the region on April 2 and it will support British Overseas Territories during the upcoming hurricane season, as well as being able to assist with the response to the COVID-19 pandemic if required. Also on board the vessel for Operation Broadshare is a single Wildcat AH1 from 203 Flight/815 NAS, similarly based at RNAS Yeovilton.

Right: ***A Merlin HC4 from 845 NAS at Yeovilton conducts helicopter inflight refuelling (HIFR) training on board RFA 'Argus' en route to the Caribbean.*** *Crown Copyright*

In Brief

RAF continues counter-IS air strikes

A pair of RAF Typhoon FGR4s flew air strikes in support of a counter-terrorism operation in northern Iraq on April 10. The Typhoons, assisted by an RAF Reaper drone, identified terrorists from so-called Islamic State (IS) occupying fortified buildings west of Tuz Khurma. According to the MOD, the aircraft "conducted a thorough check of the area for non-combatants, before using a combination of precision-guided bombs to destroy the buildings".

RAF declares IOC for Poseidon

The RAF formally declared initial operating capability (IOC) for its new P-8A Poseidon MRA1 maritime patrol aircraft on April 1. The milestone came after delivery of two aircraft to Kinloss Barracks, Scotland, where they arrived on February 4 and March 13. Seven more Poseidons are still to be delivered. The aircraft are currently operated by Nos 54 and 120 Squadrons, which will move to the type's permanent home at RAF Lossiemouth later this year.

Dutch F-16 at Tucson goes lo-viz

Kees van der Mark

THE FLAGSHIP of the Tucson, Arizona-based 148th Fighter Squadron 'Kickin' Ass' of the Koninklijke Luchtmacht (Royal Netherlands Air Force, RNLAF) was recently repainted in a non-standard colour scheme, including toned-down roundels.

The aircraft, F-16AM J-010 'AZ/148 FS', emerged from the Air National Guard (ANG) paint shop in Sioux City, Iowa, in the standard USAF colour scheme rather than the Dutch one, which differs slightly. All markings – except the combined Arizona/Dutch flag at the fin tip – are now in shades of grey. Furthermore, '148 FS' titles have been added and the tail markings are applied in shadow lettering.

The 148th FS/Netherlands Detachment Tucson Arizona (NTDA) is part of the Arizona ANG's 162nd Fighter Wing at Morris ANG Base and operates ten RNLAF F-16 Mid-Life Update (MLU) aircraft for pilot training, comprising five F-16AMs and five F-16BMs. **Kees van der Mark**

Dutch Chinook developments

BOEING DELIVERED the first of 14 CH-47F Multiyear II Common Avionics Architecture System (MYII CAAS) helicopters ordered by the Koninklijke Luchtmacht (Royal Netherlands Air Force, RNLAF), on April 3.

The first aircraft, D-472, was handed over to the Defence Materiel Organisation (DMO) at Boeing's Philadelphia production facility. The RNLAF will receive the Multi R2 Block 1 variant of the Chinook with 9.4-version software for the CAAS cockpit. The RNLAF will be the first foreign air arm to fly this version, which is the standard model for the US Army. However, the Dutch aircraft will receive a number of additional modifications, such as a floor with flexible loading system, fast-roping system for special forces missions and crashworthy crew seats.

Originally, official handover was planned for April 16, the 75th anniversary of operating unit 298 Squadron 'Grizzlies' at Gilze-Rijen Air Base. However, plans were changed when anniversary celebrations were postponed to later this year. In the meantime, the unit's Chinooks are flying with a large badge on the tail, while CH-47D D-666 has received a special colour scheme.

The RNLAF currently flies a mix of 11 CH-47D aircraft (two more were lost in accidents in Afghanistan) and six early-standard CH-47F (NL) aircraft, the latter entering service in 2012. The CH-47F (NL) is a customised variant of the US Army's CH-47F, with additional features including more powerful engines and a different cockpit layout. The main difference between the CH-47D and CH-47F is the milled construction of the F-model's fuselage. The single-piece construction reduces vibration as well as inspection and repair requirements. It also eliminates flexing points to increase service life and simplify maintenance.

The RNLAF operates four CH-47F (NL) Chinooks at the Joint Dutch Training Detachment (JDTD) at Fort Hood, Texas, which is responsible for the initial military qualification training of Dutch crews.

The first six brand new CH-47Fs are planned to be delivered to the JDTD from June. The first two aircraft are expected to arrive in the Netherlands at the end of the year. After modifications, they will be officially handed over to the RNLAF in early 2021. All aircraft are expected to arrive by the end of 2021, providing for 15 aircraft at Gilze-Rijen and five at Fort Hood.

With delivery of the new aircraft to Gilze-Rijen, the old D-models will be progressively withdrawn from service by the end of 2021.

The current six CH-47F (NL) aircraft are all now in the US for upgrade by Boeing and will receive the same layout and configuration as the new CH-47F MYII CAAS aircraft. **Frank Visser**

***Above:** The RNLAF's 298 Squadron presented specially painted CH-47D D-666 'The Beast' at Gilze-Rijen on March 17. Prepared by technicians from 980 Maintenance Squadron at Woensdrecht, it features a large dragonfly on the left side, taken from the unit's badge, in addition to '75 Years 298 Sqn' titles, which are repeated on the right side of the fuselage, together with the image of a grizzly bear.* *Jeroen van Veenendaal/Kerosene Creations*

Turkey's first ATR 72 MPA prepares for delivery

TURKEY'S MELTEM III programme is making progress with the completion of certification tests of the first ATR 72-600 Turkish Maritime Patrol Aircraft (TMPA) in Italy. The latest edition of Turkish Aerospace's house magazine, published on April 18, said that following completion of trials the aircraft had returned to TAI's Ankara-Kahramankazan facility in Turkey at the beginning of March for final testing prior to delivery to the Türk Deniz Havacılığı (Turkish Naval Aviation).

Under the Meltem III contract, six ATR 72-600TMPAs and two ATR 72-600TMUAs (Turkish Maritime Utility Aircraft) are being delivered. The two TMUAs were handed over in July and August 2013 after being modified from commercial passenger aircraft.

The far more extensive TMPA conversion – which includes various structural modifications for the MPA, anti-submarine warfare and anti-surface warfare role – has taken considerably longer. The first 'green' airframe arrived at TAI's facilities on April 19, 2013 but did not make its first flight after being modified until July 14, 2016. It left the same day for Turin, Italy, to begin certification testing by Finmeccanica from the Alenia Aermacchi (now Leonardo) flight test centre at Turin Airport. This proved more complicated than anticipated, which has delayed the delivery date, which had been originally scheduled for February 2017.

TMPA modifications include two weapons pylons on each side of the fuselage and integration of Thales Airborne Maritime Situation Control System-300 (AMASCOS-300) mission equipment. A total of ten AMASCOS-300 systems have been purchased, including four as spares. **Dave Allport**

Third upgraded ATL 2 delivered

DASSAULT AVIATION announced on April 28 that a third modernised Atlantique 2 (ATL 2) Standard 6 maritime patrol aircraft had been delivered to the Marine Nationale (French Navy) at Lann Bihoué naval air station, Brittany, by the Direction générale de l'armement (DGA, France's defence procurement agency).

The aircraft underwent an upgrade with Dassault and Thales, including the addition of a new Searchmaster radar and acoustic subsystem from Thales, a navigation console designed by Dassault and tactical display subsystem consoles developed by the defence ministry's SIAé aeronautical maintenance centre. Included in the package is a new Wescam optronic turret, already integrated on some ATL 2s under a previous urgent operational requirement.

The DGA awarded Dassault a contract for the Standard 6 upgrade in October 2013. The programme covers 18 aircraft, of which seven are being reworked by the manufacturer between 2019 and 2023. In parallel, SIAé will upgrade 11 aircraft.

***Below:* Atlantique 2 serial 16 – the third to be upgraded to Standard 6 – prepares to depart Istres on its return to Lann Bihoué.** *Dassault Aviation*

51° Stormo begins QRA mission

THE 51° Stormo (51st Wing) of the Aeronautica Militare (AM, Italian Air Force) has officially begun quick reaction alert (QRA) duties with the F-2000 Typhoon at Istrana air base, northern Italy. The wing's 132° Gruppo (132nd Squadron) is now responsible for the air defence mission, after it received its first Typhoons last year.

Since 2017, F-2000s and crews from other AM wings had been rotationally deployed to Istrana for QRA duties. Last year, however, the 51° Stormo attained full operational capability with the type, after activation of the required maintenance facility, including provision for full technical inspections. Currently, the F-2000 is operated alongside 132° Gruppo's AMX A-11s – flying the tactical reconnaissance mission – which are scheduled to be withdrawn later this year.

***Above:* One of the first Typhoons in 51° Stormo markings, MM7316 '51-01' at Istrana last September.** *Marco Rossi*

Istrana is the fourth AM base to be equipped with frontline Typhoons, following Grosseto (4° Stormo), Gioia del Colle (36° Stormo) and Trapani (37° Stormo).

Croatian Kiowas get Hellfire missiles

THE OH-58D fleet operated by the Hrvatsko ratno zrakoplovstvo (HRZ, Croatian Air Force) has received its first live AGM-114R Hellfire II missiles, the country's defence ministry confirmed on April 17. With the receipt of the anti-armour weapons in mid-April, the Kiowa Warriors of the 393. eskadrila helikoptera (393rd Helicopter Squadron) at Zadar-Zemunik have declared full operational capability.

The HRZ's Kiowa Warrior received software upgrades for the use of Hellfire, and the squadron's pilots underwent conversion training using inert rounds. Delivery of the Hellfires was agreed in 2017, under the US Military Foreign Sales (FMS) programme.

***Above:* Following the fatal crash of OH-58D serial 327 on January 20, the HRZ restarted flights with the type in mid-March. This Kiowa Warrior carries a training Hellfire during a mission last year.** *MORH via Antonio Prlenda*

Turkish A400Ms complete COVID-19 missions

A400M AIRLIFTERS from the Türk Hava Kuvvetleri (THK, Turkish Air Force) have been notably active in recent weeks, transporting aid to European countries affected by the COVID-19 pandemic. The ten-aircraft fleet serves with 221 Filo 'Esen' (221 Squadron 'Breeze'), part of the 12'nci Hava Ulaştırma Ana Üs Komutanlığı (12th Air Transport Main Base Command) at Erkilet-Kayseri.

On April 8, A400M 15-0051 flew from Ankara to five Balkans countries, bringing humanitarian supplies to Northern Macedonia, Montenegro, Serbia, Bosnia and Herzegovina and Kosovo.

Two days later, the same aircraft delivered supplies of personal protective equipment (PPE) for medical staff into RAF Brize Norton, Oxfordshire. Following an agreement between the UK and Turkey, Ankara supplied 250,000 items of PPE equipment, including face masks, surgical masks and protective suits.

The delivery to Brize Norton by the THK came after 37 tonnes of UK aid was supplied by an RAF C-17 to those affected by the crisis on Turkey's border with Syria (see *RAF Globemaster III delivers aid for Idlib crisis*, May, p9).

Another THK A400M, 16-0055, also visited RAF Mildenhall, Suffolk, on April 28, as 'OAN2902' – reported to be a NATO high-priority callsign.

Crown Copyright

Another Royal Norwegian Air Force AW101 delivered

AN ADDITIONAL Leonardo AW101 Mk612 has been delivered to the Luftforsvaret (Royal Norwegian Air Force, RNoAF). The helicopter, 0277/ZZ108 (c/n 50277/NOR09), left the factory in Yeovil, Somerset, using callsign 'NOW330C' on March 4, initially for a fuel stop at Humberside Airport, Lincolnshire, before continuing the next day to Stavanger-Sola Flystasjon, Norway. It will initially be used by the RNoAF's operational test and evaluation unit before being issued to 330 Skvadron.

This was the seventh AW101 delivered to the RNoAF to date, the most recent prior to this having been in June 2019. At present only six are operational. The 'missing' helicopter is the first one that was delivered, 0268/ZZ103 (c/n 50268/NOR04), which, as previously reported, was badly damaged in a roll-over accident while ground running at Sola on November 24, 2017, only a week after delivery (see *Attrition*, January 2018, p91). Although it has since been rebuilt by the manufacturer (see *Attrition*, January 2020, p86) it was still undergoing flight test from the factory at Yeovil in mid-March and has not yet been returned. Another of the earlier deliveries, 0265/ZZ102 (c/n 50265/NOR03), also temporarily moved back to Yeovil during March for maintenance; it was test flying there on May 1 and was expected to return home shortly afterwards.

The next two of these helicopters for the RNoAF – 0276/ZZ107 (c/n 50276/NOR08) and 0278/ZZ109 (c/n 50278/NOR10) – were both seen at Yeovil during March being prepared for delivery. A total of 16 are on order to replace the RNoAF's elderly Westland Sea King Mk43Bs. **Dave Allport**

French Air Force mobilises Morphée A330 MRTT

THE ARMÉE de l'Air (French Air Force) has begun using its Morphée medical evacuation (medevac) module in its response to the coronavirus. The Morphée (Module de Réanimation pour Patient à Haute Elongation d'Evacuation) is installed in an A330 Phénix Multi-Role Tanker Transport (MRTT) aircraft. On April 8, NATO reported that the air arm had flown six missions with the Morphée unit since March 18, under the framework of Opération Résilience, the military operation in the context of the COVID-19 pandemic.

France has 19 Morphée 'pods' – ten Intensive Care Modules (ICM) and nine Light Care Modules (LCM) – that were certified for use aboard the Phénix last December. With the module fitted, a Phénix aircraft can carry six to 12 seriously ill patients and accompanying medical staff more than 6,214 miles (10,000km).

Phénix serial 041 (c/n 1735, F-UJCG) of the Escadron de Ravitaillement en Vol et de Transport Stratégiques (ERVTS, Strategic Air-to-Air Refuelling and Transport Squadron) 1/31 'Bretagne' was operating between Basel and Hamburg Airport, where it was photographed on March 31. *v1images.com/Dirk Grothe*

New look for Flugbereitschaft's Cougar

LUFTWAFFE AS532U2 Cougar 82+02 (c/n 2452) of the air arm's Flugbereitschaft des Bundesministeriums der Verteidigung (Flight Service of the German Ministry of Defence) at its home base of Berlin-Tegel Airport on April 6. This is the first of three examples on strength with the unit to receive a new paint scheme, with Germany's national colours of black, red and gold replacing the previous livery, which incorporated three shades of blue applied in a broadly similar pattern, but with the cheatline running along the bottom of the cabin.

Timm Ziegenthaler

COVID-19 delays Croatian fighter tender

THE ECONOMIC crisis caused by the COVID-19 pandemic has led the Croatian government to delay its current tender for a future multi-role fighter for the Hrvatsko ratno zrakoplovstvo (HRZ, Croatian Air Force).

On April 2, defence minister Damir Krstičević announced the process was postponed until further notice and stressed that some of the potential bidders had requested a delay in the procedure.

In a renewed effort to purchase modern fighters, the Croatian government had sent a request for proposal (RfP) on January 15 to the United States for new F-16 Block 70/72s, Sweden for new JAS 39 Gripens, France for secondhand Rafales, Italy for secondhand Eurofighters, and to Norway, Greece and Israel for secondhand F-16s. The deadline for initial responses to the RfP was May 7. Croatian Prime Minister Andrej Plenković announced that potential bidders will be officially informed about a new date for submission of proposals.

The HRZ is looking to replace its seven MiG-21bisD single-seat and four MiG-21UMD two-seat fighters belonging to the 191. eskadrila lovačkih aviona (191st Fighter Squadron) at Zagreb-Pleso. Technical resources allow these aircraft to be operated only until mid-2024.

On January 10 last year, the government announced it had rejected a previously accepted Israeli offer of 12 secondhand F-16C/D Baraks, plus a simulator, basic weapons and support for infrastructure, training and maintenance. The reason was that the US Congress had only approved the sale of the Israeli F-16s in a basic configuration, which would involve additional costs for modernisation by US companies and represent a breach of the terms of the tender. **Antonio Prlenda**

Danish, Dutch, French and Swedish fighters over the North Sea

***Above:** Two Flottille 12F Rafale Ms trail their tail hooks as they formate with a pair of Royal Danish Air Force F-16AM/BMs during Mission Foch over the North Sea.* *French MoD*

THE MARINE Nationale (French Navy) has announced details of a "high-intensity" air combat manoeuvring exercise that took place in the North Sea from March 19-21. Mission Foch pitted Rafale Ms of French carrier strike group Task Force 473 against their counterparts from the air forces of Denmark, the Netherlands and Sweden.

The Foch mission was led by Task Force 473 around the aircraft carrier *Charles de Gaulle*, which was taking part in operations involving European maritime and territorial approaches and co-operating with allied forces.

On March 19, two Flottille 12F Rafales 'engaged' two Dutch F-16s guided by land-based air traffic controllers from the Netherlands within Danish airspace. Four Rafales then protected the carrier strike group from attack by four Swedish Gripens guided by an E-2C Hawkeye from the French flagship.

The next day, Rafales intercepted four Gripens which 'threatened' the carrier strike group. Aircraft from both nations were guided by Swedish air traffic controllers. Two Royal Danish Air Force F-16s supported by two Rafales then faced two opposing Rafales guided by a French E-2C, while a Marine Nationale NH90 Caïman Marine helicopter found and designated targets for the fighters.

The exercise ended on March 21 with a final tactical scenario involving two Danish F-16s that engaged two French Rafales guided by an E-2C.

Maiden flight for Luxembourg's A400M

***Above:** Luxembourg Armed Forces A400M serial CT-01 lands at Seville airport, Spain.* *Airbus Defence and Space*

THE SOLE A400M airlifter ordered by the Luxembourg Armed Forces completed its maiden flight from the Airbus Defence and Space final assembly line facility in Seville, Spain, on April 13. The Atlas, serial CT-01 (c/n 104), departed at 1608hrs local time (CET) and returned five hours later.

As Luxembourg has no air force of its own, the A400M will operate in conjunction with the Belgian Air Component's 15 Air Transport Wing and be flown from the unit's base at Melsbroek, Brussels International Airport.

AW169 training helicopters for Italian Army

THE ITALIAN Army is to receive two new Leonardo AW169 helicopters for pilot training, ahead of development and procurement of a new multi-role variant.

The defence ministry will procure the commercial-standard rotorcraft from Leonardo under a deal worth €337m (US$301m) before the company begins development of the multi-role AW169M, 15 of which are required.

In Brief

Bulgarian 'Vipers' contracted
Lockheed Martin has been awarded a US$512m contract to deliver eight F-16V Block 70 jets to Bulgaria. The Foreign Military Sales contract, announced on April 2, is part of a procurement and support package expected to be worth around US$1.3bn.

Luftwaffe Tornados return from counter-IS mission
After concluding their reconnaissance mission against so-called Islamic State on March 31, four Luftwaffe Tornados from Taktisches Luftwaffengeschwader 33 returned from Al-Azraq in Jordan to their home base of Büchel on April 2. The Tornados flew 2,467 missions and 7,500 flying hours during the four-year mission.

French Navy embarks first AS365N3
A first French Navy AS365N3 utility helicopter has gone to sea with a detachment from Flottille 35F assigned to the frigate *La Fayette* off Toulon from April 20 to 25. The navy leased four Dauphin N3s as a stopgap pending the arrival of the new H160M Guépard.

Gripen flies with X-band radar
Saab has completed the first airborne trials of a Gripen fighter equipped with a new X-band active electronically scanned array radar. This will be offered as a new addition to Saab's PS-05/A radar family and can be adapted to a variety of platforms.

Air force Rafale deploys with Reco NG
Rafale fighters of the French Air Force that are engaged in fighting so-called Islamic State under Opération Chammal have received the new Thales Reco NG reconnaissance pod. The pod became operational at the French base at Muwaffaq Salti Air Base in Jordan in late March.

17th Atlas for French Air Force
The Armée de l'Air received its 17th A400M airlifter at Orléans-Bricy air base on April 24. France's military programme law provides for the delivery of 11 A400Ms, for a total of 25 aircraft in service by the end of 2025.

New designations, old problems for Croatia

Detail changes have been made to the Croatian Air Force's order of battle, but the coronavirus has spelled bad news for ambitions to modernise the fighter arm, as **Antonio Prlenda** reports.

Faced with the uncertainty caused by the COVID-19 pandemic, Croatia has decided to delay its current tender for a future multi-role fighter to equip the Hrvatsko ratno zrakoplovstvo (HRZ, Croatian Air Force).

Prime Minister Andrej Plenković announced on April 2 that potential bidders will be officially informed about a new date to submit their proposals. An official request for proposal (RfP) had been sent to France, Greece, Israel, Italy, Norway, Sweden and the United States, with an initial deadline for responses of May 7 (*Croatia issues RfP for new fighter*, March, p12). The government also announced that the first Croatian International Military Air Show (CROIMAS), due to take place at Zadar in May, has been delayed until next year.

Name changes

Since last autumn, the HRZ has been using a new designation system within its structure. The previous two air bases (Zrakoplovna baza) have become wings (Krilo), while squadrons have received numeric identifiers. The title of the sole fighter squadron has also been modified – it is no longer the Eskadrila borbenih aviona (literally, Combat Aviation Squadron), but instead the Eskadrila lovačkih aviona (Fighter Aviation Squadron).

In the Croatian capital of Zagreb, the 91. krilo (91st Wing) now consists of:

- 191. eskadrila lovačkih aviona 'Vitezovi' (191st Fighter Squadron 'Knights') with single-seat MiG-21bisD and two-seat MiG-21UMD fighters at Zagreb-Pleso Airport
- 194. eskadrila višenamjenskih helikoptera (194th Utility Helicopter Squadron) with Mi-171Sh *Hip* helicopters at Zagreb-Lučko Heliport

At Zadar-Zemunik, home of the Središte za obuku HRZ 'Rudolf Perešin' (Air Force Training Centre 'Rudolf Perešin'), the 93. krilo (93rd Wing) now comprises:

- 392. eskadrila aviona (392nd Fixed-Wing

In May last year, Austrian authorities finally handed over the former Yugoslav MiG-21R serial 26112 in which a first Croatian pilot defected to Austria in 1991. He later joined the Croatian forces to continue fighting. *Davor Perkovac via Antonio Prlenda*

***Above:* Pending the outcome of the second tender for a new multi-role fighter, the HRZ is relying on its ageing MiG-21bisD interceptors for air defence.** *Tomislav Haraminčić via Antonio Prlenda*

Squadron) with Zlin Z 242L and Pilatus PC-9M trainers

- 393. eskadrila helikoptera (393rd Helicopter Squadron) with Bell 206B-3 JetRangers and OH-58D Kiowa Warriors
- 395. eskadrila transportnih helikoptera (395th Transport Helicopter Squadron) with Mi-8/17 *Hip-H* helicopters at Split-Divulje Heliport
- 855. protupožarna eskadrila (855th Firefighting Squadron) with Bombardier 415 Super Scoopers and AT-802A/F Air Tractors and Fire Bosses.

Special forces and UAVs

On December 11, the Multinational Special Aviation Programme (MSAP) Training Centre (Međunarodno središte za obuku specijalnih zračnih snaga) was also established at Zadar-Zemunik. Initially, the NATO centre will train Croatian, Bulgarian, Hungarian and Slovenian helicopter crews, who will then be integrated with special operations forces. In line with the establishing of the training centre, the US government has pledged to donate two brand-new UH-60M Black Hawk helicopters in 2020-21 for use by the Croatian Zapovjedništvo specijalnih snaga (ZSS, Special Operations Command). The Ministarstvo obrane Republike Hrvatske (MORH, Republic of Croatia Ministry of Defence) has already paid US$76m in advance for another two UH-60Ms to be delivered in 2022, including a full sustainment package.

Also in December, Defence Minister Damir Krstičević announced that, from 2020, the new official day of the HRZ will be October 25, in memory of the late Rudolf Perešin, shot down by Serbian forces in 1995. He was the first Croatian pilot to defect from the former Yugoslav Air Force when he flew his reconnaissance MiG-21R *Fishbed-H* (L-14i) from Bihać to Klagenfurt, Austria, in 1991. On May 7 last year, the Austrian authorities finally handed over the jet to Croatia in exchange for decommissioned MiG-21bisD serial 110, which is now permanently displayed at Austria's Militärluftfahrt-museum Zeltweg.

In November, the MORH reopened the military part of Pula Airport to establish the Središte za besposadne zrakoplovne sustave (Unmanned Aerial Systems Centre). The centre is part of the Središnjica za obavještajno djelovanje (SOD, Intelligence Operations Headquarters), which is directly subordinated to the Glavni stožer Oružanih snaga Republike Hrvatske (GS OSRH, the General Staff of the Armed Forces of Republic of Croatia). The centre's main asset is six Israeli Aeronautics Ltd Orbiter 3 tactical UAVs, while the SOD also operates a small number of indigenously made M-99 Bojnik and Israeli Elbit Skylark I mini-UAVs. AFM

To celebrate its 15th anniversary, the Krila Oluje display team at Zadar-Zemunik finally received a smoke system. This PC-9M completed first tests of the new equipment in March. *Tomislav Haraminčić via Antonio Prlenda*

‘Bones’ demonstrate global presence in Indo-Pacific

A 28th BW B-1B approaches a KC-135 to refuel over the Pacific on April 29. *USAF/ Senior Airman Cynthia Belío*

B-1B BOMBERS from the USAF’s Air Force Global Strike Command (AFGSC) conducted a series of long-range missions to the Indo-Pacific arena recently.

A pair of Lancers assigned to the 28th Bomb Wing (BW) from Ellsworth Air Force Base, South Dakota, flew a 32-hour round-trip to conduct operations over the South China Sea as part of a joint US Indo-Pacific Command (USINDOPACOM) and US Strategic Command (USSTRATCOM) Bomber Task Force (BTF) mission on April 28-29. The Lancers used the callsigns ‘Snark 11 and 12’ and their route took them close to Okinawa, Japan, and then towards Andersen Air Force Base, Guam.

In a press release, the USAF said the operation demonstrated its “dynamic force employment model in line with the National Defense Strategy’s objectives of strategic predictability with persistent bomber presence, assuring allies and partners.”

The mission followed an April 22 bilateral training event in which a B-1B from the 28th BW’s 37th Bomb Squadron integrated with six USAF F-16s and 15 Japan Air Self-Defense Force fighters near Japan (see *JASDF F-2s fly with B-1B and F-16s*, p26).

USSTRATCOM has flown BTF missions (previously known as Bomber Assurance and Deterrence missions) since April 2014, to demonstrate commitment to collective security and integrate with operations by geographic combatant commands. However, the Lancer has not been active in the USINDOPACOM area of responsibility since January 2018, when the 9th Expeditionary Bomb Squadron from Dyess AFB, Texas, took part in a six-month Continuous Bomber Presence mission at Andersen AFB. Last October, B-1Bs from Ellsworth AFB also conducted a BTF mission in the US Central Command area of responsibility.

Third RCAF FWSAR C295 flown

AIRBUS DEFENCE and Space has flown the third CC-295 aircraft for the Royal Canadian Air Force’s (RCAF’s) Fixed-Wing Search and Rescue (FWSAR) programme. The manufacturer announced on April 23 that the aircraft, 295503 (c/n 190), is currently completing production test flights at Seville-San Pablo Airport, Spain, prior to delivery.

As previously reported, the first FWSAR CC-295, 295501 (c/n 183), took to the air on July 4 last year (see *Maiden flight for Canada’s CC-295,* August 2019, p18). The second aircraft, 195502 (c/n 185), was also flying by September. Formal acceptance of the first example took place in Seville on December 18 (see *RCAF’s first CC-295 formally accepted*, February, p16), but it remained in Spain for further testing, training and initial operational test and evaluation before planned transfer to Canada in mid-2020.

The third Royal Canadian Air Force FWSAR CC-295, 295503, during a pre-delivery test flight from Seville. *Airbus Defence and Space*

The only CC-295 to have arrived in Canada to date is 295517 (c/n 187), a dedicated maintenance training airframe, which is additional to the 16 operational aircraft on order. This left Seville on delivery on January 28 (see *CC-295 FWSAR trainer delivered to Canada*, March, p16).

Since *AFM* reported details of that aircraft, it has emerged that a total of three dedicated maintenance training aircraft are on order, as part of the separate deal for the FWSAR training package; the remaining two will be 295518 and 295519. **Dave Allport**

Fort Campbell units prepare for overseas deployments

UNITS OF the US Army’s 101st Airborne Division (Air Assault) at Fort Campbell, Kentucky, are preparing for a number of overseas deployments. Two of these were announced by the army on April 24. The main deployment will bring the 101st Combat Aviation Brigade (CAB) ‘Wings of Destiny’ to Europe with AH-64s, CH-47Fs and UH-60/HH-60s. They will replace the 3rd Infantry Division CAB supporting Operation Atlantic Resolve.

A smaller element of the 101st CAB – B Company ‘Pachyderms’, 6th Battalion – will deploy to Afghanistan to provide aviation support with additional CH-47Fs and aircrews. They will replace the 10th Mountain Division CAB as part of a regular rotation of forces supporting Operation Freedom’s Sentinel. B Company will be attached to Task Force Ivy Eagle, part of the 4th Infantry Division CAB.

A third deployment, announced on April 23, will be the rotational deployment of the 2nd Squadron, 17th Cavalry Regiment (2-17th CAV), 101st CAB, to South Korea this summer. The 2-17th CAV will provide crews and support for AH-64Es and RQ-7B Shadow unmanned aerial vehicles, replacing the 7th Squadron, 17th Cavalry Regiment from Fort Hood, Texas, at the completion of its rotation. The squadron will undertake a nine-month tour in South Korea before returning to Fort Campbell. **Dave Allport**

First USMC Reaper flight in Middle East

US MARINE Corps pilots and sensor operators from Marine Unmanned Aerial Vehicle Squadron 1 (VMU-1) ‘Watchdog’ conducted their first operational flight of an MQ-9A Reaper unmanned aircraft system in the Middle East on March 20. VMU-1 crews took control of a company owned/company operated MQ-9A supporting forward-deployed marines.

F-15E and F-35A buzz Al-Tanf in Syria

US SPECIAL Operations Joint Task Force – Operation Inherent Resolve released a number of images in April showing a USAF F-35A and F-15E making low passes over the US military base at Al-Tanf Garrison in southeastern Syria's Homs governorate. The move is seen as most likely intended as a morale booster for the US personnel operating from this remote desert outpost, which is at the centre of a 34-mile (55km) radius deconfliction zone.

In addition, it demonstrates that the US is ready and able to defend its personnel, wherever they may be, while also continuing to strike at extremist organisations in Syria.

The initial photographs released showed an F-35A flying over Al-Tanf on April 10. Unit markings are not visible on the aircraft, but it is likely to have been one of the six 388th Fighter Wing (FW) examples that were temporarily forward-deployed to Muwaffaq Salti Air Base in Jordan to support missions in Iraq and Syria.

Four days later, on April 14, F-15E 87-0201 'MO' from the 366th FW's 389th Fighter Squadron 'Thunderbolts' at Mountain Home Air Force Base, Idaho, performed a flyover near Al-Tanf after carrying out a practice strafing run. The unit also has aircraft currently deployed to Muwaffaq Salti Air Base to support missions in Iraq and Syria. **Dave Allport**

USAF/366th Fighter Wing/389th Fighter Squadron F-15E 87-0201 'MO' over Al-Tanf Garrison on April 14, having performed a practice strafing run. *US Army/Staff Sgt William Howard*

Draken receives ex-Jordanian Mirage

***Above:* Former RJAF Mirage F1DJ 118 shortly after its arrival at Draken International's headquarters at Lakeland Linder International Airport, Florida.** *Draken International*

DRAKEN INTERNATIONAL has received its first former Royal Jordanian Air Force (RJAF) Mirage F1. The company announced the jet's arrival in the US on April 3. The aircraft involved is two-seat Mirage F1DJ 118 (c/n 539), formerly CE.14C-85 with the Spanish Air Force and originally F1DDA QA62 with the Qatar Emiri Air Force. The aircraft – previously stored at the RJAF's Al Azraq Air Base – has been delivered to the company's headquarters at Lakeland Linder International Airport, Florida. It is believed that additional ex-RJAF Mirages are being acquired, but precise details have yet to be confirmed.

Draken International's impressive fleet now includes 27 MiG-21bis/MF/UMs, 22 ex-Spanish Air Force Mirage F1Ms and F1Bs, up to 21 L-159E Honey Badgers, 13 ex-Royal New Zealand Air Force A-4K/TA-4K Skyhawks, 12 ex-South African Air Force Cheetahs and five L-39 Albatros jet trainers.

On March 26, the company announced that it had begun flying its most recent acquisitions, the ex-Spanish Mirage F1Ms, for Red Air aggressor flying from Nellis Air Force Base, Nevada. **Dave Allport**

F-16 receives latest Operational Flight Program software

THE US Air Force Materiel Command has announced release of the latest software innovations for the USAF's F-16 fleet.

Operational Flight Program (OFP) M-series 7.2+ became available in April for more than 600 of the service's Block 40/42/50/52 Fighting Falcons.

The US$455m programme provides a range of capability upgrades, including compatibility with the new active electronically scanned array (AESA) radar, integration with the AGM-158 Joint Air-to-Surface Standoff Missile-Extended Range (JASSM-ER), as well as the latest AIM-120 Advanced Medium-Range Air-to-Air Missile (AMRAAM), an Integrated Communication Suite and no fewer than 42 other enhancements.

Development of OFP M7.2+ involved more than 300 personnel at seven locations.

The OFP Combined Test Force (CTF), Eglin Air Force Base, Florida, conducted over 4,200 sorties and 4,600 flight hours in support of the programme, including participation in last year's Exercise Northern Edge.

USAF/56th Fighter Wing/310th Fighter Squadron F-16C 89-2056 'LF/56 FW', in full-colour wing commander markings, returns to Luke Air Force Base, Arizona, in the late afternoon of April 29. It had reportedly been making a practice flight for a flypast to honour local first responders that took place on May 1. *Nate Leong*

Hill F-35As support Eielson transition

***Above:** A pilot from the 354th FW pre-flights F-35A 17-5258 'HL' from the 388th FW at Hill AFB, Utah, on April 27.* *USAF/Todd Cromar*

FOUR F-35As from the USAF's 388th Fighter Wing (FW) deployed from their home station of Hill Air Force Base, Utah, to Eielson AFB, Alaska, to help establish operations by the newly established 354th FW (see *Eielson welcomes F-35A*, p7).

The Lightning IIs from Hill's 388th FW – the USAF's first combat-coded F-35A wing – completed their four-hour flight across the Pacific Northwest on April 27. The jets will become part of the 354th FW's inventory for two months. The Hill aircraft joined the first two F-35As delivered to Eielson by Lockheed Martin the previous week. Eielson is scheduled to receive two or three new F-35s monthly until the wing reaches a total of 54 aircraft in two squadrons by early 2022.

Bare-metal OC-135B

Dylan Phelps

THE USAF's Open Skies OC-135B 61-2670 performs a functional check flight from Tinker Air Force Base, Oklahoma, on April 23. The Open Skies aircraft was still in bare metal following more than seven months of heavy maintenance work. As this is one of the very last C-135s still equipped with TF33 engines, there's a good chance it won't be seen unpainted again, as the aircraft are approaching the end of their service life. Serial 61-2670 was at RAF Brize Norton, Oxfordshire, in April 2018 (see *Open Skies OC-135B in the UK*, May 2017, p7).

Avionics Tech Refresh for U-2S

THE USAF has awarded Lockheed Martin an Avionics Tech Refresh (ATR) contract for continued work on the U-2S high-altitude reconnaissance aircraft fleet. The deal is valued at US$50m and includes an updated avionics suite that modernises the U-2's onboard systems to readily accept and use new technology, and a new mission computer designed to the air force's open mission systems (OMS) standard. This will enable the U-2 to integrate with systems across air, space, sea, land and cyber domains. The package also adds new cockpit displays to make pilot tasks easier and enhance presentation of data.

Lockheed Martin will lead the design, integration and test of the new ATR components, and the U-2 will be the service's first fully OMS-compliant fleet. Interim fielding is anticipated to begin in mid-2021, with fleet modification expected in early 2022.

The ATR programme is the first step within a wider upgrade plan that will eventually add new sensor technology and systems updates, known as Dragon STAR (Sensors Technology and Avionics Refresh.

Pegasus fixes agreed

BOEING AND the USAF have reached an agreement on reworking the KC-46A Pegasus aerial refuelling tanker's problematic Remote Vision System (RVS), including high-definition colour cameras, operator stations with larger screens, a laser rangefinder and boom assistance augmented reality.

The USAF will also provide the company with US$882m in previously withheld payments to help it deal with the effects of the coronavirus on its manufacturing base.

CH-53K aerial refuelling tests

US NAVAL Air Systems Command announced on April 9 that the US Marine Corps CH-53K completed an air-to-air refuelling sortie during which it 'hooked up' with a KC-130J aerial refuelling tanker for wake survey testing. The 4.5-hour trial, undertaken the same week over the Chesapeake Bay, did not involve any transfer of fuel.

Lockheed Martin

According to the CH-53K test team, the trial assessed the performance of the helicopter when flying behind the tanker in strong, turbulent air. The aircraft's crew successfully plugged the drogue at increasing closure rates to ensure the King Stallion could handle the forces on the refuelling probe when contacting the drogue.

The USMC is working to complete developmental test before embarking on the planned initial operational test and evaluation next year, followed by first fleet deployment in 2023-24.

First HC-130J for US Air Force Reserve

Lockheed Martin

LOCKHEED MARTIN has delivered a first HC-130J for the US Air Force Reserve. The Combat King II, 17-5892 'FL', took off from the company's Marietta, Georgia, production facility on April 2 on its way to its new home at Patrick Air Force Base, Florida. The fixed-wing personnel recovery aircraft will be assigned to the 39th Rescue Squadron (RQS), part of the 920th Rescue Wing (RQW).

The 39th RQS/920th RQW are the air force reserve's only HC-130J operators and previously flew the HC-130P King.

The 14th and final example of the HC-130P assigned to the wing – 69-5830, known as 'King 30' – departed Patrick AFB, Florida, on August 7, 2017, and was flown to the 309th Aerospace Maintenance and Regeneration Group (AMARG) at Davis-Monthan Air Force Base, Arizona, to be decommissioned.

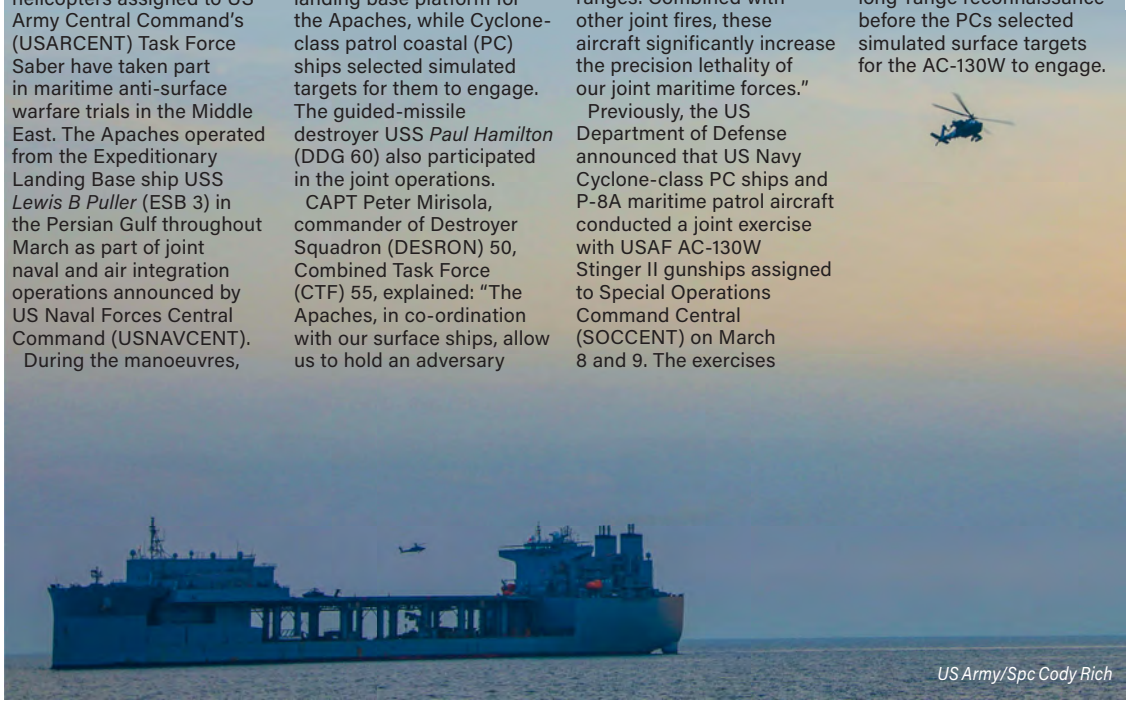
Apache maritime strike trials in Persian Gulf

AH-64E APACHE attack helicopters assigned to US Army Central Command's (USARCENT) Task Force Saber have taken part in maritime anti-surface warfare trials in the Middle East. The Apaches operated from the Expeditionary Landing Base ship USS *Lewis B Puller* (ESB 3) in the Persian Gulf throughout March as part of joint naval and air integration operations announced by US Naval Forces Central Command (USNAVCENT).

During the manoeuvres, the *Puller* served as a landing base platform for the Apaches, while Cyclone-class patrol coastal (PC) ships selected simulated targets for them to engage. The guided-missile destroyer USS *Paul Hamilton* (DDG 60) also participated in the joint operations.

CAPT Peter Mirisola, commander of Destroyer Squadron (DESRON) 50, Combined Task Force (CTF) 55, explained: "The Apaches, in co-ordination with our surface ships, allow us to hold an adversary at high risk at extended ranges. Combined with other joint fires, these aircraft significantly increase the precision lethality of our joint maritime forces."

Previously, the US Department of Defense announced that US Navy Cyclone-class PC ships and P-8A maritime patrol aircraft conducted a joint exercise with USAF AC-130W Stinger II gunships assigned to Special Operations Command Central (SOCCENT) on March 8 and 9. The exercises involved P-8s performing long-range reconnaissance before the PCs selected simulated surface targets for the AC-130W to engage.


US Army/Spc Cody Rich


US Navy/Mass Communication Specialist 3rd Class Zachary Melvin

First VERTREP for USS *Gerald R Ford*

A US Navy MH-60S Seahawk conducts a vertical replenishment-at-sea from the fleet replenishment oiler USNS *Joshua Humphreys* (T-AO 188) to the aircraft carrier USS *Gerald R Ford* (CVN 78) on March 24. The US Navy aircraft carrier conducted its first vertical replenishment (VERTREP) with MH-60S helicopters attached to Helicopter Sea Combat Squadron 9 (HSC-9) 'Tridents' while under way in the Atlantic Ocean. The milestone took place while *Ford* was taking part in its 18-month Post-Delivery Test and Trials (PDT&T) phase, to ensure overall deployment readiness. *Ford* completed the VERTREP of 77 pallets of food and other dried goods in just over four and a half hours.

In Brief

'Air Force One' maintenance completed
A joint USAF-Boeing team finished maintenance on VC-25A serial 29000 ahead of schedule, under an effort led by the Air Force Life Cycle Management Center's Presidential and Executive Airlift Directorate. Air Force Materiel Command announced completion of the work on April 14.

Eight more F-35Bs for 1st MAW
The 3rd Marine Aircraft Wing's (MAW's) Marine Fighter Attack Squadron 122 (VMFA-122) and VMFA-211 have delivered eight recent-production F-35Bs to the 1st MAW's VMFA-121 at Marine Corps Air Station Iwakuni, Japan. VMFA-121 permanently relocated from MCAS Yuma, Arizona, to MCAS Iwakuni in 2017.

Next ANG F-35A bases
The Department of the Air Force has selected Truax Field, Wisconsin, and Dannelly Field, Alabama, for the next two Air National Guard F-35A locations. The USAF expects F-35As to begin arriving at Truax and Dannelly Fields in 2023, where they will be operated by the 115th Fighter Wing and 187th Fighter Wing respectively.

AESA upgrade for USMC 'legacy' Hornets
The US Marine Corps has begun refitting 98 F/A-18C/Ds with the AN/APG-79(V)4 active electronically scanned array (AESA) radar. Naval Air Systems Command awarded Raytheon US$30.2m to procure the radars for the first nine 'legacy' Hornets, with deliveries to be completed by May 2022.

1,000th refuelling contact for VAW-120
The US Navy's Airborne Command & Control Squadron 120 'Greyhawks' achieved its 1,000th aerial refuelling (AR) contact on April 16. The milestone came when the E-2D and its crew were conducting an initial AR qualification flight off the US east coast.

More Stingrays for navy
Boeing has been awarded a US$84.7m contract modification funding three additional MQ-25 system demonstration unmanned aircraft, bringing to seven the total number of Stingrays that the manufacturer is contracted to build.

Upgraded *Blackjacks* back in service

THE RUSSIAN defence ministry has announced redelivery of a pair of modestly upgraded Tu-160M1 *Blackjacks* to the Vozdushno-Kosmicheskiye Sily (VKS, Russian Aerospace Forces). Specialists from the 264th Military Representation of the Ministry of Defence accepted the two strategic missile carriers, named *Ivan Yarygin* and *Vasily Reshetnikov*, on April 23. The aircraft's inertial navigation and engine control systems, as well as armament, have been enhanced using "modern digital technologies".

Russia is refurbishing and upgrading Tu-160s to the so-called M1 ('small modernisation') level at a rate of one or two aircraft annually. Interestingly, both these aircraft had been previously seen with all the external features of the M1 standard. Tu-160 *Ivan Yarygin* ('04 Red', RF-94112) was presented at the ARMY-2019 exhibition at Kubinka in June last year, while *Vasily Reshetnikov* ('02 Red', RF-94102) was at the MAKS 2019 airshow at Zhukovsky last August. Furthermore, last March 12, *Vasily Reshetnikov* was intercepted over the Atlantic by RAF Typhoons from RAF Lossiemouth, Scotland. This suggests some last minor corrections may have been made in April before formal delivery. **Piotr Butowski**

The two Tu-160M1s ('Ivan Yarygin' nearest camera) that were handed over on April 23. One noteworthy new feature is the Long-Range Aviation emblem on the forward fuselage. *UAC*

Ukrainian MiG-29MU2 armed with Kh-29T

A PHOTO has emerged of a Povitryani Syly (PS, Ukrainian Air Force) MiG-29 fighter flying with a Kh-29T (AS-14 *Kedge*) TV-guided air-to-surface missile under its port wing. This confirms reports from January that flight tests of the upgraded MiG-29MU2 have begun. This standard is intended to supersede the locally modernised MiG-29MU1 that entered service in 2009. Developed by the PS in co-operation with the Lviv State Aircraft Repair Plant (LSARP), the MiG-29MU2 introduces a modified radar and precision ground-attack weapons including the Kh-29T missile and KAB-500Kr TV-guided 500kg (1,102lb) bomb. Also included are an upgrade of the 20PM weapon system, a further update of the R-862 radio station, installation of the Kurs-93 navigation/landing aid, a replacement of the RSBN A-323 navigation system and use of the MSD-2000 data bus.

Ukrainian MoD

Army aviation winner in Aviadarts-2020

CREWS FROM a "Leningrad unit" of the VKS have been selected as the best within the Russian army aviation branch, the defence ministry has announced, following the second stage of the Aviadarts-2020 competition.

Accompanying photographs showed Ka-52, Mi-8MTV-5 and Mi-28N helicopters, among them examples from the 332nd Independent Helicopter Regiment (332 OVP), part of the 6th Air Force and Air Defence Army.

The regiment has elements based at Pribylovo and Pushkin, both near St Petersburg, suggesting that this was the victorious unit. Turn to p72 for more on the 6th Air Force and Air Defence Army.

Rockets are fired from a Mi-8MTV-5, presumed to be from the 332 OVP, which has squadrons of 'Hips' at Pribylovo (one) and Pushkin (two). *Russian MoD*

New name for *Bear*

Evgeniy Kazennov

THIS VKS Tu-95MSM, '24 Red', RF-94130 (c/n 3834415), has begun carrying a new honorific name – *Murmansk*, after the port city in Russia's far northwest. The strategic missile carrier was overhauled and modernised by the Beriev Aircraft Company at Taganrog and departed for its home airfield at Engels on April 11 last year (see *Beriev delivers two more upgraded Tu-95MSMs*, June 2019, p21).

In Brief

Azerbaijan considers buying Russian fighters
An Azerbaijani defence ministry delegation visited aircraft manufacturers in Russia in early April. The team saw production of Su-30SMs at Irkutsk and an Azerbaijani pilot apparently flew in a Russian Knights Su-30SM at Kubinka. An official statement also mentioned tours of "manufacturers of Su-35 and MiG-35" fighters and familiarisation flights in a MiG-35.

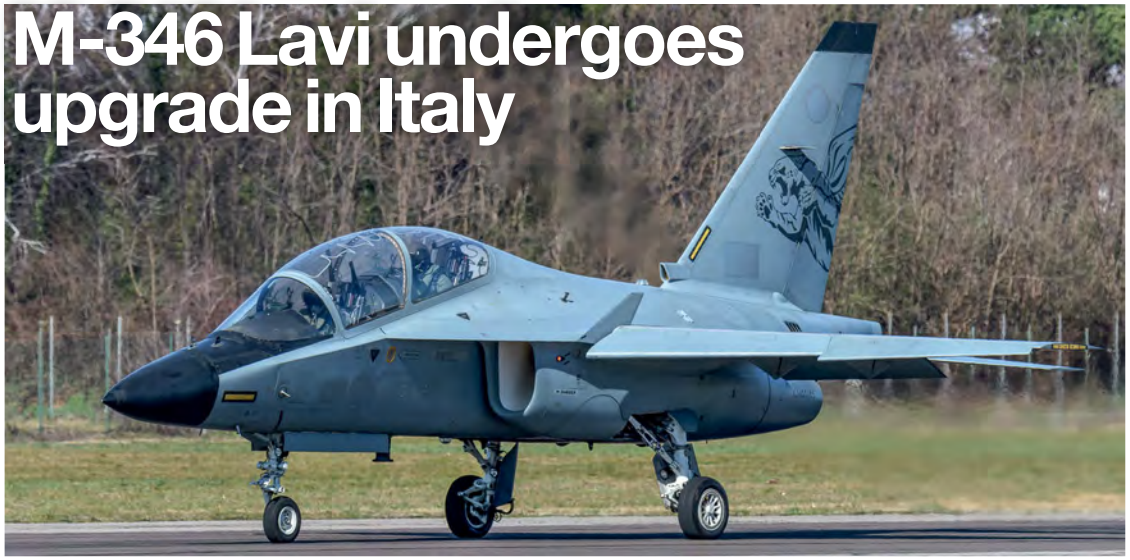
Russia to get three Mi-38 command posts
The Russian defence ministry has ordered three Mi-38 helicopters in a new airborne command post version, scheduled to be manufactured in the first half of next year. The command post helicopter has received the internal code Mi-38-7, or izdeliye 2607.

***Bears* train over the Pacific**
Two Tu-95MS strategic missile carriers of the VKS performed a long-range flight over international waters of the Sea of Japan and northwestern Pacific, the Russian defence ministry announced on March 24. The *Bear-Hs* were airborne for more than nine hours and at times were escorted by Japan Air Self-Defense Force fighters.

Russian transports in Serbia

SIX VKS Il-76MDs have provided military assistance to Serbia as part of that country's efforts to respond to the coronavirus pandemic. The provisional air group from the 224th Flight Detachment (224 LO) based in Tver, consisted of *Candid-Bs* RA-76713, RA-78762, RA-78816, RA-78817, RA-78831 and RA-78832, which carried military units and equipment between Chkalovsky, northeast of Moscow, and the Serbian air base of Batajnica. A total of 11 flights took place on April 3 and 4. Transported were 87 personnel, including eight teams of doctors and nurses, plus troops from Russia's radiation, chemical and biological defence units and 16 decontamination vehicles.

M-346 Lavi undergoes upgrade in Italy



Above: ***M-346 Lavi 117, now registered again as CSX55185, concludes a test flight from the Leonardo Aircraft Division factory at Venegono on March 4. Belonging to 102 Squadron 'Flying Tiger', based at Hatzerim, it was the tenth Lavi delivered, on March 22, 2015.*** *Marco Muntz*

A MAJOR avionics upgrade on an Israeli Air Force (IAF) M-346 Lavi is continuing at the Leonardo factory in Venegono, northern Italy. Last September 26, Lavi 117 returned to Venegono from its home base at Hatzerim, following a technical stop at Lecce-Galatina air base, southern Italy.

The Lavi was ferried to Italy wearing its previous test registration and with IAF serial and roundels concealed, although the 102 Squadron 'Flying Tiger' markings remained on the tail.

The aircraft is undergoing a comprehensive modernisation, including new software and internal modifications. It will serve as prototype for an upgrade destined for the IAF's 30-strong M-346 fleet and was expected to remain in Italy for around one year.

All 30 Lavis were delivered to the IAF between July 2014 and June 2016. Upon arrival in Israel, the service began enhancing the type's capabilities in close collaboration with Leonardo. Four successive programme block updates have been carried out, mainly adapting the avionics to enable new flight configurations. The IAF's Flight Test Squadron at Tel Nof has been responsible for testing and evaluating each upgraded block prior to introduction to the fleet. Since June 2017, all Lavis have been capable of carrying drop tanks and BDU-33 practice bombs for operational training. The current upgrade will further enhance capabilities and optimise the IAF's pilot training process. **Marco Muntz**

In Brief

Qatar's Bayraktar TB2 enters service

A Qatari-operated Bayraktar TB2 UAV has been noted for the first time taking part in military manoeuvres during Exercise Al-Adheed 2020. In footage released by the Qatari defence ministry on April 1, the Turkish-made drone was seen taxiing and taking off in unarmed configuration, but it was reported to have undertaken precision strikes during live firing at the Qurain Abu al-Bawl training area in the south of the country. Qatar ordered six TB2s, three ground control stations and a training simulator in a deal announced in March 2018.

GlobalEye delivered

Saab announced handover of the initial GlobalEye Swing Role Surveillance System aircraft to the United Arab Emirates Air Force and Air Defence on April 29. The UAE has ordered three GlobalEyes, which are based on the Global 6000 airframe, with an initial contract signed in late 2015. Last November the country also announced its intention to purchase an additional two systems.

Exercise Enduring Lightning

ISRAELI AIR Force (IAF) F-35I Adir and USAF F-35A jets have taken part in Exercise Enduring Lightning, the first joint training manoeuvres dedicated to the fighter to be held by Israel.

Hosted in late March, the exercise involved F-35Is from the IAF's 140 Squadron 'Golden Eagle' from Nevatim Air Base and F-35As from the USAF's 34th Expeditionary Fighter Squadron, currently deployed to Al Dhafra, in the United Arab Emirates.

Equipped for signals intelligence (SIGINT), Gulfstream GV Nachshon Shavit aircraft also participated in the manoeuvres, which saw the F-35s from both nations tackle aerial and ground threats. The exercise was held exclusively in the air, with no face-to-face encounters between the Israeli and US aircrew, and briefings and debriefings were conducted through classified communications devices.

Peter R Foster

Omani Hercules visits UK

ROYAL AIR Force of Oman (RAFO) C-130J serial 505 (c/n 5739) from 16 Squadron at Seeb-Muscat returns to Oman on March 9 following a period of maintenance by Marshall Aerospace and Defence Group at Cambridge City Airport in the UK.

In August 2010, Lockheed Martin announced that the RAFO had ordered two C-130Js for projected delivery in late 2013 and early 2014 respectively. The first was officially accepted into service in April 2014 and was followed by the second during early May that year. Two more C-130Js were ordered during 2014 and are yet to be delivered.

The RAFO also operates a single C-130J-30, an order for which was announced in June 2009. This aircraft was delivered in mid-September 2012.

Israeli display team performs over country's hospitals

THE PLANNED flyover marking Israel's Independence Day on April 29 was dramatically scaled back due to COVID-19. This year, the Israeli Air Force's aerobatic team flew over the country's hospitals only. The team from the Flight Academy at Hatzerim Air Base – flying four T-6A Efroni trainers – performed over 22 hospitals, to acknowledge medical teams and the healthcare system. The flyby began in the Tel Aviv area, before heading north to Nahariya and Safed, then to Israel's most southern point of Eilat, before routing back to the centre of the country.

Anthony Hershko

More AB206s delivered to Argentine Army

THE FÁBRICA Argentina de Aviones (FAdeA) delivered two Agusta-Bell AB206B-1 helicopters to the Comando de Aviación de Ejército (CAE, Argentine Army Aviation Command) on April 9. Serials AE-312 and -314 were followed on the 18th of that month by another three examples, serials AE-325, -326 and -327, destined for other state operators.

All are part of a batch of 20 AB206s the Argentine government purchased from its Italian counterpart following use by the Italian Carabinieri. While AE-312 and -314 are allocated to the Argentine Army, the second batch includes one machine for the Prefectura Naval Argentina (PNA, Argentine Coast Guard) and two for the Gendarmería Nacional Argentina (GNA). Despite plans to deliver them direct to the respective forces, they were seconded to the army to complete their certification process. The army will also conduct maintenance on the aircraft until they are finally transferred to the other forces.


FAdeA

The CAE previously received one AB206B-1 modified by Leonardo Helicopters in Italy – serial AE-310 – and a first example modified by FAdeA. Work on the army's helicopters includes a major overhaul and new interiors, including new Garmin avionics, an instrument panel with multifunction display, and Harris radios. Those for the GNA and the PNA are not being modernised.

The army's AB206s will be operated by the Escuela de Aviación de Ejército (Army Aviation School), while others, armed with M134 machine guns, will go to the Escuadrón de Aviación de Exploración y Ataque 602 (602nd Observation and Attack Aviation Squadron), and some will be operated by aviation sections deployed across the country. In total, the force will receive 15 helicopters, with three more going to the GNA and the remaining two to the PNA. **Santiago Rivas**

Mexican Navy Dash 8 undergoes maintenance

Andrew H Cline

THE ARMADA de Mexico's (Mexican Navy's) sole DHC-8-Q202, ANX-1230 (c/n 582, ex AMT-230), spent part of the winter in the much colder climes of North Bay, Ontario, Canada, where it received attention from Voyageur Aviation. The Dash 8 returns to North Bay every other winter for its periodic heavy maintenance. It's seen here recovering to North Bay Jack Garland Airport after a post-overhaul test flight before returning to Mexico in February.

The single Dash 8 entered Armada de Mexico service when it was delivered new in March 2001. It's operated by the Escuadrón Aeronaval de Alto Mando based at Estación Aérea Militar 1 at Benito Juárez International Airport in Mexico City. **Andrew H Cline**

Sixth IA-63 Pampa III handed over

THE ARGENTINE defence ministry has announced that the Fuerza Aérea Argentina (FAA, Argentine Air Force) has received its sixth IA-63 Pampa III advanced jet trainer/light attack aircraft. The aircraft – serial A-705 (c/n 1033) – was delivered to the II Escuadrón (2nd Squadron), part of VI Brigada Aérea (6th Air Brigade), at Tandil air base in Buenos Aires province on March 27.

The Pampa III was produced by the Fábrica Argentina de Aviones (FAdeA) factory in Córdoba and joins five examples already operational. The air arm accepted its first Pampa III in November 2018, after a maiden flight in September that year. The previous aircraft delivered was serial A-704 – the fifth production Pampa III – which was handed over last November 19 (see *Additional Pampa III delivered to Argentina*, January, p22).


The latest Pampa III, serial A-705, on its delivery flight to Tandil. *Christian Giaccaglia via Santiago Rivas*

Although Argentina plans to acquire 18 examples, contracts have only been placed for the first six.

The Pampa III is one of the few modern aircraft remaining in the FAA's inventory and is primarily used in the nation's North Shield operation, protecting its northeast border.

In Brief

An-178 production continues for Peru

Ukraine's Antonov Company has announced that work is continuing on the first An-178 twin-jet military transport ordered for Peru's Ministry of Interior. Despite the coronavirus pandemic, manufacture is still under way under "quarantine conditions" and preparatory work has been completed ahead of jig assembly of the fuselage. By mid-April, assembly of the nose and fuselage centre section were nearing conclusion. Manufacture of the central part of the wing, left and right cantilever parts of the wing and the empennage have been finished and two engine pylons are also ready for integration.

Argentine FA-50 plans foiled

Korea Aerospace Industries' (KAI's) plans to export the FA-50 light fighter to Argentina have been put on hold indefinitely. While media sources in South Korea quoting KAI officials attribute the measure to the outbreak of COVID-19, *AFM* understands that the decision was made due to a continued lack of funds for military expenditure in Argentina, and lack of progress on the deal since December.

New Argentine rotary UAV

A NEW rotary-wing unmanned aerial vehicle (UAV), the Asteri RUAS 160, has been unveiled by a consortium of Argentine companies – Cicaré Helicópteros, INVAP and Marinelli. A prototype of the drone was presented at the Expoagro agriculture fair that took place in San Nicolás, Buenos Aires province, from March 10-11. The UAV is intended for defence and security applications, including search and rescue, as well as for agricultural work.

The Asteri has contrarotating rotors of 10ft 2in (3.1m) in diameter and is powered by a 40hp (30kW) two-stroke gasoline engine. Cargo capacity is 176lb (80kg) and maximum take-off weight 353lb (160kg). The manufacturers hope to have a refined version of the drone ready for production next year.

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Maiden flight for Nigerian Super Tucano

THE INITIAL A-29B Super Tucano light attack, combat and reconnaissance aircraft for the Nigerian Air Force (NAF), serial 19-2033, completed its inaugural flight on April 16. The milestone sortie took place at Jacksonville, Florida, home of the production facility operated by Embraer Defense & Security and Sierra Nevada Corporation (SNC). Twelve A-29Bs ordered for the NAF are currently in production by SNC and Embraer at Jacksonville and the first delivery is scheduled for next year.

The initial NAF Super Tucano will now begin mission modification and final testing in Centennial, Colorado. When this is complete, NAF pilots and maintainers will train on the aircraft with the USAF's 81st Fighter Squadron 'Panthers' at Moody Air Force Base, Georgia. A-29 training has been conducted at Moody AFB for the Afghan Air Force since 2014. The first Nigerian A-29s are expected to arrive at the Georgia base this summer and the unit is scheduled to become fully operational in winter 2021.

***Above:** The first A-29B for the NAF, serial 19-2033, over Northeast Florida Regional Airport, Saint Augustine, Florida, on April 20 during a test flight from Jacksonville.* Brian Evans

In December 2018, SNC and Embraer Defense & Security received the US$329m contract for the 12 A-29s for the NAF. The deal includes ground training devices, mission planning and debriefing systems, spares, ground support equipment, alternate mission equipment, contiguous US interim contractor support, outside of continental US (OCONUS) contractor logistic support and field service representatives for OCONUS support.

Ukrainian contingent returns from Uganda

FOURTEEN PILOTS and engineers from Ukraine's state-owned Odes'kyy Aviatsiynyy Zavod (OAZ, Odessa Aircraft Plant) were evacuated from Uganda on March 27 and returned home, where they immediately began 14 days of coronavirus-related quarantine.

The Ukrainian personnel were part of an international effort involved in repairs and upgrades for six Uganda People's Defence Air Force (UPDAF) L-39 jet trainer/light attack aircraft at Gulu Air Base. According to Ukroboronprom, work on the contract was completed on March 24.

OAZ's involvement with the UPDAF L-39s in Uganda is in addition to a 2018 agreement under which the company overhauled and modernised eight other examples in Ukraine; the first pair were completed and returned to Uganda in late 2018, followed by six more aircraft last year. The final two were airlifted to Gulu on February 6 aboard a Ukrainian Air Force Il-76MD transport aircraft.

***Above:** Although of poor quality, this photo accompanying Ukroboronprom's March statement shows Ukrainian technicians in front of three UPDAF L-39s, including L-39ZA serial AF-709.* Ukroboronprom

According to Ukrainian media sources, all the Ugandan L-39s that passed through OAZ in 2018-20 were fully disassembled and their wings and fuselages checked for damage, while their Ivchenko AI-25TL engines were overhauled and upgraded to AI-25TLSh standard, providing 10% more thrust and improved control. They also received new radio and navigation equipment, including GPS, VHF omni-directional range (VOR), distance measuring equipment (DME) and instrument landing system (ILS), as well as International Civil Aviation Organization-compatible transponders and new, solid-state BUR-4-1 flight data recorders. The modernisation package for the six aircraft upgraded at Guma is likely similar, but retaining the standard AI-25TL engine.

Meanwhile, it was confirmed last December that a small contingent of Bulgarian contractors are providing training for UPDAF L-39 pilots and technicians, as well as servicing the Albatros jets operating from the military side of Entebbe Airport and from Gulu.

The UPDAF received its first three ex-Libyan Air Force L-39ZO trainers in 1987; these are still in service today. In the late 2000s, Uganda bought four ex-Bulgarian Air Force L-39ZAs, overhauled in Ukraine in 2009-10. An ex-East German L-39ZO was acquired on the civilian market shortly afterwards. At least one additional L-39ZA appears to have been sourced by 2017, but its source and original identity has yet to be established. Further L-39ZA acquisitions followed in 2018-19, when three ex-Bulgarian and one ex-Romanian aircraft were delivered after overhaul and modernisation at OAZ. **Igor Bozinovski**

Kenyan Spartan supports COVID-19 relief effort

A KENYA Air Force (KAF) C-27J Spartan transport is among the aircraft that Leonardo has made available, together with some of the manufacturer's pilots, to support the Italian Protezione Civile (Civil Protection Department) as it deals with the COVID-19 national emergency. The aircraft are being used to transport personnel, medical equipment and critical items including respirators and masks within Italy, as well as abroad.

Taking part in the effort is KAF C-27J serial 222 (CSX62308), the third example for the service, which had not yet been delivered from the manufacturer's Turin-Caselle facility. Also involved is ATR 72-600 (CSX62318), which is thought to be the second example scheduled for conversion to anti-submarine warfare/maritime patrol configuration for the Turkish Navy; the first, TCB-751 (CSX62296/MT62296) is now ready for delivery to Turkey.

KAF C-27J Spartan serial 222 takes off from Turin-Caselle. *Marco Rossi*

Rotary assets made available by Leonardo Helicopters include a pair of AW139s and a single AW198.

In Brief

Harpoon missiles for Moroccan F-16s

The Royal Moroccan Air Force plans to arm its F-16C/Ds with AGM-84L Harpoon Block II anti-shipping missiles after the US State Department approved the sale of ten of the weapons in April. The package is valued at US$62m and, according to the US Defense Security Cooperation Agency, will "enhance capabilities in effective defence of critical sea-lanes."

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JASDF F-2s fly with B-1B and F-16s

Above: The 28th Bomb Wing B-1B is flanked by a pair of 3 Hikotai F-2As (nearest camera) and three F-16CJs from the 35th Fighter Wing, off the coast of northern Japan. *USAF*

F-2 FIGHTERS of the Japan Air Self-Defense Force (JASDF) took part in a bomber-fighter integration exercise over Draughon Range near Misawa, Japan, on April 22. Seven F-2s teamed up with the single 28th Bomb Wing B-1B – callsign 'Hyper 21' – that flew a 30-hour round-trip to the Indo-Pacific region from Ellsworth Air Force Base, South Dakota. Also involved were six USAF F-16CJs assigned to the 35th Fighter Wing at Misawa Air Base and eight JASDF F-15s. According to a US Pacific Air Forces statement, the joint US Indo-Pacific Command (INDOPACOM) and US Strategic Command (USSTRATCOM) Bomber Task Force mission involved bilateral and theatre familiarisation training.

This was the year's second CONUS-based bomber bilateral training exercise with the JASDF. On February 3, two B-52Hs integrated with six USAF F-16s and more than 45 JASDF fighters near Misawa AB. The JASDF inventory includes 64 single-seat F-2As and 27 two-seat F-2Bs serving chiefly with the 3 Hikotai at Hyakuri, 6 and 8 Hikotai at Tsuiki and 21 Hikotai at Matsushima.

New transport squadron for PAF

THE PAKISTAN Air Force (PAF) has established a new air transport unit, No 52 Squadron 'Markhors' to operate a fleet of four CN235-220s. Pakistan's national animal, the markhor is a wild goat species found in the north of the country.

The CN235 fleet was previously flown by No 6 Squadron 'Antelopes' – which also operated C-130s – from PAF Base Nur Khan at Rawalpindi in the province of Punjab. No 6 Squadron 'Antelopes' had operated the CN235s since the type's acquisition from PT Dirgantara Indonesia in 2002.

Both squadrons come under the command of No 35 Composite Air Transport Wing. **Waseem Abbas** *PAF*

Textron Aviation

First two U-680A Citation Sovereigns for JASDF

TEXTRON AVIATION has delivered the first two of three Cessna U-680A Citation Sovereigns to the Japan Air Self-Defense Force (JASDF). The U-680A is based on the Cessna Citation Latitude 680 but configured to perform special missions. In JASDF service, the platform will be operated in a flight inspection role, replacing the air arm's last YS-11FC, which is scheduled to be retired this year.

The first two aircraft – serials 02-3031 (c/n 680A-0140) and 02-3032 (c/n 680A-0185) – were handed over to the Hiko Tenkentai – the Flight Check Squadron – part of the Tokubetsu Koku Yusodai (Special Airlift Group) at Iruma Air Base in Saitama, Japan on March 20. The third aircraft will be delivered early next year.

The JASDF's U-680A is equipped with Norwegian Special Mission's UNIFIS 3000 flight inspection system, which will support the platform's mission in providing periodic evaluation of navigational aids, such as flight procedures and electronic signals to ensure accuracy and safety.

Second Global Hawk delivered to ROKAF

Above: An image posted to US Ambassador to South Korea Harry Harris's Twitter account shows an ROKAF RQ-4B at an unidentified location. *US Ambassador to South Korea*

THE SECOND of four RQ-4B Block 30 Global Hawk unmanned aircraft systems (UAS) for the Republic of Korea Air Force arrived in the country in April, following delivery of the first example last December (see *ROKAF introduces Global Hawk*, February, p27). US Ambassador to South Korea Harry Harris confirmed handover of the second aircraft in a tweet on April 19. The first ROKAF RQ-4B had arrived at Sacheon Air Base in South Gyeongsang province on the southern tip of the Korean peninsula on December 23. Two examples were expected to be delivered in April.

Seoul ordered a total of four Global Hawks under a Foreign Military Sales (FMS) deal in 2011. The operating unit is the 296th Tactical Reconnaissance Squadron, part of the 39th Tactical Reconnaissance Group.

Philippines offered AH-1Z or AH-64E

The US State Department has approved a possible Foreign Military Sale to the Philippines of six new attack helicopters – either AH-64E Apache or AH-1Z Venom aircraft. While the proposed AH-64E purchase is valued at US$1.5bn, the AH-1Z package would cost US$450m. Both deals include AGM-114 Hellfire missiles and Advanced Precision Kill Weapon System (APKWS) kits.

Second PLAAF transport division receives Y-20A

***Above:** Y-20A serial 20041 from the 13th Transport Division's 37th Air Regiment was seen at Wuhan in March.* via @人民画报 from Weibo and ChinaPictorial

THE CHINESE People's Liberation Army Air Force (PLAAF) has established a second transport division flying the Y-20A. Images shown in several TV reports and social media during the COVID-19 crisis showed six of the strategic transports taking part in a medical relief mission to Wuhan Tianhe International Airport in March. This first confirmed large-scale operational use of the Y-20 not only revealed several more previously unknown aircraft assigned to the 4th Transport Division's 12th Air Regiment based at Chengdu/Qionglai, within the Southern Theater Command, but also the first two Y-20As from the 13th Transport Division under the Central Theater Command. This unit was long expected to become the second PLAAF division and, according to their serial numbers, they are assigned to the 37th Air Regiment, a former Y-8C unit based at Kaifeng. **Andreas Rupprecht**

Philippine Coast Guard H145s on COVID-19 support

A PAIR of H145s recently acquired by the Philippine Coast Guard (PCG) were already being put to good use during March and April, transporting personal protective equipment and essential materials to personnel working to contain the COVID-19 pandemic in the country. In addition, they have been used to conduct aerial surveillance at the Manila Bay Anchorage, monitoring cruise ships to ensure health protocols are strictly implemented. The PCG is also utilising its fixed-wing fleet of BN-2A-21 Islanders to transport vital equipment and supplies.

The first PCG H145, CGH-1451 (c/n 20273, ex D-HADK), was airfreighted from Germany to the Philippines last November 5. After reassembly and flight-testing by Airbus Helicopters Philippines at its facility at Manila Domestic Airport, it entered service earlier this year. The second helicopter, CGH-1452 (c/n 20292, ex D-HADD), is believed to have arrived in the country in late January. It was then reassembled and made its first test flight at Colonel Jesus Villamor Air Base on February 4 before entering operational service with the PCG, with which it made its first official flight on February 26. Both H145s are based at Villamor, replacing two elderly PCG Bo 105s in the search and rescue, medical evacuation, maritime patrol and law enforcement roles.

***Above:** Newly delivered PCG H145 CGH-1452 transports personal protective equipment and essential materials for PCG personnel, medical officers and a deployable response group in Coast Guard District Southern Visayas on March 27.* PCG

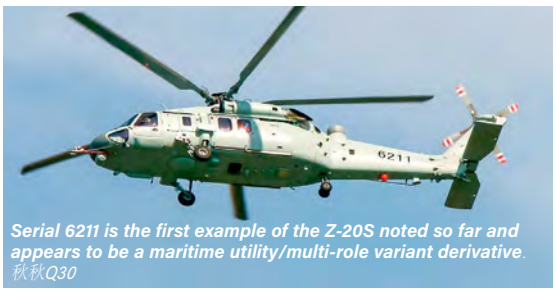
The PCG initially ordered just one H145 under a contract announced by the manufacturer on September 26, 2018, believed to have been finalised the previous July. In November 2018, the Philippines issued a notice to proceed to Airbus Helicopters for the purchase of the second H145. Personnel who will operate the helicopters completed their training at Manching, Germany, last year. **Dave Allport**

Naval Z-20 variants break cover

IMAGES HAVE emerged of two naval variants of China's Z-20 helicopter. Entering service with the People's Liberation Army Ground Force (PLAGF) last year as a medium-weight transport helicopter, it was long expected that the Z-20 would also be adapted for People's Liberation Army Navy duties. The recently posted images were allegedly taken last year and show that the Harbin Aircraft Industry Group has developed two different maritime versions.

Compared with the Z-20 operated by the PLAGF, the modifications common to both navalised versions include revised undercarriage, with the tail wheel moved forward to a position behind the cabin, shorter struts for the forward undercarriage, as well as the capability to fold the tail ahead of the tail rotor for stowage in a ship's hangar.

The first appears to be a utility/multi-role variant referred to as the Z-20S and comparable with the MH-60R Seahawk. This variant was also photographed carrying eight air-to-surface missiles mounted outboard of the forward undercarriage sponsons.



Serial 6211 is the first example of the Z-20S noted so far and appears to be a maritime utility/multi-role variant derivative. 秋秋Q30

The second variant appears to be the anti-submarine-warfare-capable Z-20F, expected to become the standard naval helicopter on all major vessels, gradually replacing the Z-9 and Ka-28. In contrast to the Z-20S, the Z-20F has a prominent radar below the forward fuselage and features revised stub-pylons for external stores such as torpedoes. **Andreas Rupprecht**

In Brief

Advanced Hawkeyes arrive in Japan
The third and fourth E-2D airborne early warning and control aircraft for the Japan Air Self-Defense Force – serials 01-3473 and 01-3474 – have arrived in Japan. The aircraft – from a batch of 13 on order – were shipped to Marine Corps Air Station Iwakuni in March ahead of formal handover to 601 Hikotai at Misawa Air Base.

Japan Coast Guard orders two more H225s
The Japan Coast Guard has ordered two more H225 helicopters, to bring its Super Puma fleet to 15, comprising two AS332s and 13 H225s. The new helicopters will be utilised for territorial coastal activities, security enforcement, as well as disaster relief missions.

Thailand abandons T-50TH plans
The Thai government has scrapped an intended purchase of two T-50TH advanced jet trainers and will instead channel funds towards COVID-19 recovery. Bangkok had previously outlined its aim to add to the Golden Eagle fleet, for a total of 14 aircraft.

India to buy extra Ka-31s
India is fast-tracking negotiations to acquire six more Ka-31 airborne early warning and control helicopters. In May last year, the defence ministry announced plans to buy ten Ka-31s, but the expected funding was not made available. Currently, 14 aircraft serve with INAS 339 'Falcons' at Goa.

FTC-2000G records first export sale
Cambodia and Myanmar have been identified as candidates for the first export sale of the Guizhou Aircraft Industry Corp (GAIC) FTC-2000G multi-role combat aircraft. The deal was signed in late January and deliveries of an undisclosed number of jets are due to begin early next year.

Hellfire II and APKWS for Indian Seahawks
Indian Navy MH-60Rs will be delivered together with AGM-114R Hellfire II missiles and Advanced Precision Kill Weapon System (APKWS) rockets. The 24 Seahawks on order will otherwise be the same configuration as those delivered to the Royal Saudi Naval Forces.

RAAF Poseidon at Paya Lebar

Hans Jacobs

ROYAL AUSTRALIAN Air Force (RAAF) P-8A Poseidon A47-007 (c/n 63187, ex N862DS) over Paya Lebar, northwest Singapore, in March, while deployed to the base for surveillance of the South China Sea. According to local accounts, the RAAF maritime patrol aircraft replaced an example of the same type from the US Navy as a result of the coronavirus pandemic. The RAAF P-8A's operating unit is No 11 Squadron from RAAF Base Edinburgh, South Australia.

Singapore gave approval to the basing of a US Navy P-8A at Paya Lebar under a December 2015 agreement. Since then, the aircraft has patrolled the disputed waters of the South China Sea, with regular deployments rotating through Singapore.

Additional Triton UAVs ordered for Australia

AUSTRALIA IS moving ahead with plans to acquire six MQ-4C Triton unmanned aircraft systems (UAS) after the US Department of Defense announced plans to issue Northrop Grumman a sole-source contract to supply two more of the high-altitude, long-endurance (HALE) drones. A notification posted on a US government website on April 14 confirmed the move, which adds to the single Triton already under contract.

The latest contract modification covers two unfunded option lines for five additional MQ-4Cs, comprising three for the US Navy and two for the RAAF, plus two additional main operating bases, one for each of the services.

In May last year, Northrop Grumman was awarded a US$65m contract for long-lead components for the manufacture and delivery of three Low-Rate Initial Production (LRIP) Lot 5 MQ-4Cs, including the first for Australia, along with one ground station. This work was expected to be completed in June this year. The second and third Australian Triton will be included in Fiscal Year 2021 LRIP Lot 6. All six Tritons will eventually be based at RAAF Base Edinburgh, South Australia, and deployed to RAAF Base Tindal, Northern Territory, as necessary.

Camcopter completes heavy-fuel engine tests for RAN

SCHIEBEL HAS completed acceptance tests for the Royal Australian Navy (RAN) of its Camcopter S-100 unmanned air system (UAS) fitted with the company's heavy-fuel S2 engine. The Austrian company announced the development on March 9, with the trials campaign taking place at Nowra, New South Wales. The new engine is initially cleared for JP-5 (F-44) and Jet-A1 fuels and is intended to increase operational performance and maintainability.

According to the manufacturer: "The enhancements offered by the S2 engine will enable the RAN to continue to expand their test and evaluation programme, examining advanced vertical take-off and landing (VTOL) UAS capabilities ahead of the SEA 129 Phase 5 programme." SEA 129 Phase 5 will select the future UAS capability for the RAN's new Arafura-class offshore patrol vessels (OPVs), as well as other ships.

During the recent tests, the Camcopter S-100 was equipped with an L3 Harris Wescam MX-10 real-time electro-optical/infrared camera and an automatic identification system (AIS).

Schiebel

Latest milestones for Loyal Wingman

BOEING AUSTRALIA has announced another two significant developments in the RAAF's Loyal Wingman – Advanced Development Program: weight on wheels and aircraft power on, achieved for the first of three prototypes. The milestones for the unmanned aircraft came after completion of the first fuselage (see *First Loyal Wingman fuselage assembly*, May, p28), after which work focused on systems installation and functional and integration testing.

Dr Shane Arnott, programme director of the Boeing Airpower Teaming System (ATS), said: "We're continuing at pace toward our goal of flying later this year, so that we can show our customer and the world what unmanned capability like this can do."

The production of the ATS is intended for the RAAF and export customers.

Boeing Australia

First-of-class flight trials for HMAS *Adelaide*

THE ROYAL Australian Navy (RAN) announced on April 7 that it has staged a series of first-of-class flight trials aboard the landing helicopter dock (LHD) vessel HMAS *Adelaide* off the Queensland coast. The three-week training phase was designed to increase the operational capability of the warship and its Aviation Support team, including determining safe operating limits for the MH-60R helicopter in a range of sea states and wind speeds, day and night.

The procedure saw the Aircraft Maintenance and Flight Trials Unit (AMAFTU) work alongside *Adelaide's* Aviation Support team, which conducted deck handling and crash-on-deck exercises. Also assessed were aviation facilities, equipment calibration and evaluation of the interface between the helicopter and class of ship.

Lieutenant Commander Chris Broadbent of the AMAFTU explained: "While MH-60R aircraft have been used on HMA Ships *Adelaide* and *Canberra* for some time, new tests are required to determine what safe operating limits they can achieve when working together."

Adelaide's commanding officer, Captain Jonathan Ley, added: "The results [of the trials] will provide a new standard of operational capability, informing how the navy can employ the MH-60R and LHD together in the future, to increase both lethality in combat and responsiveness during humanitarian assistance and disaster relief tasks."

As well as the 'Romeo' from 816 Squadron in Nowra, New South Wales, the tests involved an embarked MRH90 – the two rotorcraft used the callsigns 'Cobra 15' and 'Midnight', respectively.

***Above:* Embarked MH-60R callsign 'Cobra 15' lands on board HMAS 'Adelaide' during first-of-class flight trials.** *ABIS Jarrod Mulvihill/Commonwealth of Australia*

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Reaching for

Over the past two years, Britain's military has made significant developments in its air combat capabilities. ***Alan Warnes*** *looks at how UK combat air is planning for the future.*

The RAF's Project Centurion Typhoons took over from the Tornado GR4 in December 2018, after nearly 40 years of sterling service by the swing-wing type. The same month saw the UK's F-35B Lightning achieve Initial Operating Capability (Land). This milestone came just five months after Project Tempest had been launched at the Farnborough International Airshow in July 2018. The Future Combat Air System Technology Initiative (FCAS TI) is being heralded as a sixth-generation option to replace the Typhoon by 2040. Tempest has not only provided a vision of a future warfighting platform, but has also encouraged the UK's military aerospace industry to look at a raft of prospective new technologies. Until then, the industry's future had looked somewhat bleak.

Shouldering much of the responsibility for the integration of the Project Centurion Typhoon and F-35B into service is Air Cdre Dave 'Bradders' Bradshaw. Previously Lightning Force commander, since May last year he has been the senior responsible owner (SRO) for the RAF's combat air, accountable for the Lightning and Typhoon. He told *AFM*: "I'm charged with keeping those frontline fleets up to date with new aircraft, sensors, weapons, avionics and training systems." The previous incumbent, Air Cdre (now Air Vice-Marshal) Linc Taylor was also tasked with the embryonic Tempest project, but this has since become part of the RAF's Rapid Capabilities Office under the leadership of Air Cdre Jez Holmes.

Preparing for the cruise

Right now, the F-35B is taking up much of Air Cdre Bradshaw's time. The fifth-generation fighter is being prepared for its first operational cruise – known as Carrier Strike Group 21 or CSG21. As part of that work-up, No 617 Squadron participated in Exercise Red Flag at Nellis Air Force Base, Arizona, in early February. The air commodore told *AFM*: "It was the first opportunity to engage the Lightning Force in that high-end training environment. The whole principle of Red Flag is operating together, integrating forces so they can fight in composite air operations [COMAO] and make sure we can integrate fourth-generation with fifth-gen platforms like F-15s, F-16s and Typhoons. It is a training exercise, as high-end as we could possibly hope for."

the stars UK combat air

Above: RAF Typhoon FGR4s alongside an F-35B waiting to take on fuel from a Voyager tanker during Exercise Cobra Warrior, a three-week high-intensity large-force tactical training exercise held last year and directed from RAF Waddington, Lincolnshire. *Crown Copyright* ***Left: Air Cdre Dave 'Bradders' Bradshaw has been senior responsible owner for the RAF's combat air component since May last year. Before that, he was commander of the Lightning Force and the Tornado GR4 Force, overseeing arrival of the F-35B in the UK, declaration of Initial Operating Capability (Land) and retirement of the Tornado.*** *Crown Copyright*

A former RAF Harrier GR7/9 pilot, Air Cdre Bradshaw is now concentrating efforts on the next F-35B milestone – Initial Operating Capability (Maritime). "That's our near-term focus ensuring the Lightning Force can fight effectively from the Queen Elizabeth-class carrier. Which is the main reason 207 Squadron deployed to the carrier around the same time 617 Squadron went to Red Flag."

No 207 Squadron is the Lightning Operational Conversion Unit (OCU), responsible for training pilots for the F-35B at RAF Marham, Norfolk, alongside No 617 Squadron. The unit stood up on July 1 last year, under the command of Wg Cdr Scott Williams – as the officer commanding, he took the F-35Bs to HMS *Queen Elizabeth* for Exercise Lightning Fury. He has the huge responsibility of growing a sufficiently qualified F-35 force in time for CSG21 in autumn next year. Air Cdre Bradshaw added: "As our F-35B training unit, 207 Squadron will qualify its staff, instruct the frontline pilots and eventually new ab-initio pilots as they come through the training system."

Four ab-initio pilots trained at RAF Valley in Wales during 2017 with No IV Squadron, flying Hawk T2s, before being posted to the US Marine Corps (USMC) F-35B training unit, Marine Fighter Attack Training Squadron 501 (VMFAT-501) at Marine Corps Air Station Beaufort, South Carolina. Meanwhile, two 'creamies' (ab-initio pilots selected to become qualified flying instructors) are currently going through their F-35B conversion.

This year, during the Lightning Fury deployment between January 24 and February 14, No 207 Squadron qualified five instructor pilots in day/night operations, while two further pilots with

Lightning Force – truly 'joint ops'

The Lightning Force is joint RAF/Royal Navy throughout, split 58:42% in favour of the air force, with an RAF Air Command lead and a navy deputy. Air Cdre Dave Bradshaw may be the senior responsible owner, but it's evident when talking to commanders from both services that the Lightning Force is working much better as a joint operation than Joint Force Harrier (JFH) did previously. No one will deny the RAF/Royal Navy JFH was a tense relationship, and that clearly isn't the case with the Lightning. One major improvement since those JFH days has been the agreement that a navy commander can head up an RAF squadron and vice-versa. This made it clear to the Royal Navy that the RAF really meant 'joint ops' this time. With JFH, only an RAF wing commander could head up an RAF Harrier unit and a navy commander could run the navy squadron. Currently, No 617 Squadron 'Dambusters' – arguably the most famous RAF unit – is set to see Wg Cdr John Butcher succeeded by a Royal Navy aviator, Cdr Mark Sparrow. It's undoubtedly the first occasion a Royal Navy aviator has led an operational RAF combat squadron – and a very famous one at that!

Another shot in the arm for the navy will be the establishment of 809 Naval Air Squadron (NAS) in April 2023, giving the Lightning Force two frontline units. Air Cdre Bradshaw added: "The squadrons are badged 617 Squadron and 809 NAS, but they are made up of a similar number of RAF/RN personnel. So 809 will not be ship-facing; it will do as much land as ship ops and the same for 617."

Air Cdre Bradshaw, who was a senior officer in the JFH effort, is keen to bind the RAF and Royal Navy together, by ensuring the air force 'buys into' the aircraft carriers, and the navy is similarly involved in the Lightning. "It's a fabulous example of team effort through the two services," he said.

previous carrier experience were brought up to speed on the Lightning. Landing signals officers and safety officers were also trained. Air Cdre Bradshaw continued: "Another carrier qualification period is planned later this summer, if COVID-19 doesn't alter our plans, and early next year we do the first work-up exercise for CSG21. We expect USMC F-35Bs [from Marine Fighter Attack Squadron 211 'Wake Island Avengers'] to deploy to the QE carrier in autumn 2020 and, while exact details are not yet known, I would be surprised if they didn't stop off at RAF Marham during this deployment. In spring next year, the Lightning Force will go into a more focused work-up before going into the CSG deployment."

The US Marines are coming

Cdre Adrian Orchard, another ex-Harrier pilot and current Commodore Fleet Air Arm, echoed Air Cdre Bradshaw's sentiment surrounding COVID-19: "Everything is so much harder with the virus; currently VMFA-211 is limited to what it can do and trying to get equipment over here by a certain date is challenging. But the good thing is they are determined to do it." Cdre Orchard is excited by the prospect of the USMC and UK working together on the carrier. He said: "The aim is to ensure that we work as a combined force – the UK Lightning Force learning from the USMC's experiences of working on LHDs [landing helicopter docks] while VMFA-211 will be very happy operating from a 'big deck.' This element of the deployment is very exciting. I think the learning and the mutual benefit between the two services will be quite something for embarked F-35 ops. I think a lot of people – even may I say the US Navy big decks – could learn a huge amount from the shared experience of Brits and Americans working together on the same platform. It is fascinating."

VMFA-211 will bring a lot of experience to CSG21 having been the first USMC F-35B unit to go to sea. In mid-2018, the 'Wake Island Avengers' carried out an eight-month combat deployment aboard the Wasp-class amphibious assault ship USS *Essex* (LHD 2) with the 13th Marine Expeditionary Unit (MEU). The jets operated over Afghanistan, Iraq and Syria, but more importantly tested how the USMC would use the aircraft on such deployments. Commanded by Lt Col Kyle B Shoop, VMFA-211 flew more than 50 days of combat totalling 1,200 flight hours, before Shoop handed over command to Lt Col Joseph Freshour in June last year. No 617 Squadron and the wider Lightning Force will learn from this invaluable experience during the QE cruise.

Block 4 Lightnings

Involvement of the USMC not only helps to increase the number of F-35Bs on board the carrier as the UK Lightning Force grows, but also offers fantastic opportunities for UK/US joint operations. While the UK has a requirement for 138 F-35s, only 48 are currently under contract. At the moment there are just 15 F-35Bs based at RAF Marham serving Nos 617 and 207 Squadrons, plus three with No 17 Test and Evaluation Squadron (TES) at Edwards Air Force Base, California. Three more aircraft are due for delivery in 2020, but this could be impacted by COVID-19.

At Edwards AFB, No 17 TES is coming to the end of the UK Lightning Force's initial operational test and evaluation (IOT&E) and is starting to focus on the new Block 4 F-35B. This will dovetail with declaration of the jet's Full Operating Capability (FOC) in 2025 when a new generation of weapons are integrated. Under the US-led Continuous Capability Development and Delivery (C2D2) programme, there will be a spiral delivery of software and, occasionally, hardware. Air Cdre Bradshaw explained: "Fundamentally, it's software the aircraft needs to operate as expected and [it] provides functionality to the pilot so he or

RAF Typhoon pilots from No 6 Squadron 'step' to their jets at RAF Lossiemouth as they depart for the latest instalment of Operation Azotize – the UK's commitment to Baltic Air Policing. The aircraft departed their Scottish base on April 28 for a deployment to Šiauliai air base in Lithuania. *Crown Copyright*

***Far left:** Pilots and ground crew prepare for the day's flying on the No 29 Squadron flight line at RAF Coningsby. As the OCU, this unit is charged with training personnel to man the six operational squadrons currently fielded. Ultimately, this total may increase to eight frontline squadrons.* Jamie Hunter
***Left:** Sqn Ldr Andy Edgell is at the controls of F-35B test aircraft BF-03 as it conducts an AIM-132 ASRAAM separation test flight from NAS Patuxent River, Maryland on January 27, 2017. The new Block 4 F-35B will add Meteor and SPEAR Capability III weapons during the 2024/25 timeframe.* Lockheed Martin
***Below:** Armourers from No 617 Squadron 'Dambusters' prepare Paveway IV precision-guided bombs to be loaded into an F-35B on its first operational sortie at RAF Akrotiri, Cyprus, on the late evening of June 15 last year. The first sortie over Syria the following day was a reconnaissance mission by two Lightnings escorted by Typhoons and didn't involve any ordnance being dropped.* Crown Copyright

From Centurion to Janus

Project Janus is a follow-on to Project Centurion when the Typhoons were fitted with Storm Shadow, Meteor and Brimstone. Air Cdre Dave Bradshaw explained: "Project Janus kicks on where Centurion left off. It's much more focused on things that we have to do to enable the aircraft to fly in civilian airspace and to interoperate with other coalition partners, for example, through the next-gen IFF [interrogator friend or foe] programme. There are other developments in the human-machine interface, and we are constantly trying to evolve the DASS [Defensive Aids Sub System] as the environment changes, to ensure we stay ahead.

"It is being rolled out in small, bite-size tranches with the first delivery of capability in the summer and a follow-on six months later. Janus is an ongoing cycle of predominantly software upgrades and some hardware being integrated."

she can gain as much situational awareness as possible. The [C2D2] programme is entering follow-on modernisation or Block 4 as it is known. In that schedule we should see Meteor and SPEAR [Selective Precision Effects At Range] Capability III integration during the 2024/25 timeframe and getting UK complex weapons on F-35 is going to be really important to us."

Enhancing the armoury

In March last year, BAE Systems received a funding award from Lockheed Martin for the integration of its SPEAR and Meteor beyond-visual-range air-to-air missile (BVRAAM). They will be part of an F-35B armoury that already includes MBDA's infrared-guided AIM-132 Advanced Short-Range Air-to-Air Missile (ASRAAM) and the Raytheon GPS/INS/laser-guided 500lb (227kg) Paveway IV.

At the time of the contract award, Cliff Waldwyn, head of combat air, group business development at MBDA, said: "This is a significant milestone for the UK combat air's capability. This initial package of work officially commences the integration of Meteor and SPEAR and will enhance the operational capability of the UK's Lightning Force in the future; it is also a positive step for the wider F-35 enterprise as it adds additional capability choice for international customers."

MBDA's head of military advisers, Russ Martin, told *AFM*: "The contract is effectively a four-year programme and we are a year into that now." While Martin wouldn't reveal when the first developmental test-firings would take place, he did indicate that, based on ASRAAM integration, they could be expected within the next two to three years: "The first F-35 ASRAAM developmental firing was carried out in March 2017 and it entered formal service at the beginning of last year. So we can reasonably assume the same timelines will apply to the new weapons."

Test-firings could occur in 2023 with both No 17 TES at Edwards AFB and the Integrated Test Force at Naval Air Station Patuxent River, Maryland, working with Lockheed Martin, BAE Systems, MBDA and Northrop Grumman.

The Meteor's fins are being clipped to ensure they fit into the F-35B's internal bays. To allow these modifications to be done on the front line, the military will make use of a role-change kit. Martin, a former RAF Tornado F3 pilot, said this will provide a lot more flexibility, so if a Typhoon or F-35 is operating from a forward operating base – like RAF Akrotiri in Cyprus – the missiles can be customised by the RAF.

Of the weapons themselves, Martin said the Meteor and SPEAR together would provide a much wider delivery threat than current options: "Powered by a ramjet, Meteor has an end-game performance that cannot be matched by current solid-fuel rocket missiles. The weapon's power, advanced seeker head and the increased information you get from the two-way data link, increase the probability of kill." The Meteor's flexibility means aircraft don't need to carry so many BVRAAMs in their internal weapons bays. Martin added: "That is important for air forces that do not have a large number of platforms and which may need to carry something like the SPEAR, too, for offensive missions."

SPEAR differs from glide bombs like the Small Diameter Bomb (SDB), or larger cruise missiles such as the Joint Standoff Weapon (JSOW) and Joint Air-to-Surface Standoff Missile (JASSM). Martin explained: "With the new seeker, a data link and a turbojet rather than a rocket motor, the operator can employ it autonomously from greater

An F-35B from VMFA-211 prepares to launch from the flight deck of the Wasp-class amphibious assault ship USS 'Essex' in the Indian Ocean in September 2018. This scheduled deployment included the F-35B's combat debut in USMC hands. The unit will also take part in CSG21 next year. US Navy/Mass Communication Specialist 2nd Class Chandler Harrell

In recent months, quick reaction alert Typhoons from RAF Lossiemouth and RAF Coningsby have been kept busy intercepting Russian military aircraft approaching UK airspace. On March 7, this Russian Naval Aviation Tu-142MK 'Bear-F Mod 3' was picked up by an RAF Typhoon FGR4 in "a routine response co-ordinated with several other NATO allies". *Crown Copyright*

ranges and with more flexibility than a glide weapon. SPEAR can also be used in the suppression of enemy air defences, maritime and close air support roles."

For air-to-air combat, the F-35's two internal bays could carry four Meteors while a multi-role mission might involve two Meteors and eight SPEARs. Meanwhile, Lockheed Martin has devised the new Sidekick rack to boost the number of missiles the Block 4 F-35A conventional fighter or carrier-based F-35C can carry. Three AIM-120C AMRAAMs will be fitted on a rack mounted in each of the jet's two internal bays, allowing six AMRAAMs for each aircraft.

Operational Typhoons

While the Lightning Force is working up, the Typhoon is taking most of the heat with six frontline squadrons – Nos 1 (Fighter), II (Army Co-operation), 3 (Fighter), 6, IX (Bomber) and XI (Fighter) – manning the round-the-clock quick reaction alert (QRA). They take turns to run two QRA facilities at RAF Coningsby in Lincolnshire and RAF Lossiemouth, Scotland, and are a major component of the UK's air defence shield.

For this role the Typhoons are armed with the Meteor BVRAAM or AIM-120C AMRAAM, backed up with the AIM-132 ASRAAM and the Mauser BK 27 gun. Regarding the weapons fit, Air Cdre Bradshaw commented: "While my role is to provide the suite of weapons, it is up to the operational commander to look at the threat and the demand as to what to actually fly with."

As recently as April 29, Typhoons from RAF Lossiemouth scrambled to intercept a pair of Russian Naval Aviation Tu-142 *Bear-F* long-range maritime patrol aircraft (MPA). One of the issues with Russian military aircraft is they don't usually communicate or 'squawk' an identity code to air traffic control, so the Typhoons, as well as monitoring the aircraft, also assist civilian ATC.

The intercept followed a spike in Russian activity close to UK airspace in early March. On March 12, six Typhoons – four from Lossiemouth and two from Coningsby – intercepted two Russian Tu-160 strategic missile carriers operating off the UK coast. The previous day, four Typhoons from RAF Lossiemouth intercepted two Tu-142s that approached from the northeast and flew in international airspace off the west coast of the UK, down towards the Bay of Biscay, where French assets monitored them, and then they returned north. They did not enter UK sovereign airspace. On March 7, six Typhoons intercepted a Tu-142MK *Bear-F Mod 3* MPA and a Tu-142MR *Bear-J* radio-relay aircraft. There is also a QRA at RAF Mount Pleasant, Falkland Islands, manned by No 1435 Flight, protecting UK interests in the South Atlantic.

A substantial terrorist threat still exists in the UK too. Furthermore, RAF Typhoons continue the Operation Shader commitment at RAF Akrotiri, where they have been working alongside allies since 2014 to defeat the so-called Islamic State in Iraq and Syria. Five RAF Typhoon squadrons take up four-month rotational deployments to Cyprus for the tasking.

There have also been other recent commitments, including Baltic Air Policing (BAP), for which No XI(F) Squadron Typhoons deployed to Estonia last summer. Over the four-month deployment, known as Operation Azotize, RAF Typhoons conducted a total of 21 interceptions of 56 Russian aircraft over the Baltic. As recently as April 28, No 6 Squadron took four Typhoons to Šiauliai, Lithuania, for another four-month BAP detachment, beginning on May 1.

No 1(F) Squadron from RAF Lossiemouth deployed to Iceland in mid-November last year for a month on the RAF's first ever Icelandic NATO Air Policing mission. As well as being on 24-hour standby to scramble in response to unidentified aircraft flying towards Icelandic airspace, the Typhoons flew 59 training sorties and more than 180 practice intercepts.

The most recent RAF Typhoon unit to form, No IX(B) Squadron, converted from Tornados on April 1, 2019. As well as manning the QRA at RAF Lossiemouth, the unit is the RAF's only fourth-generation aggressor squadron and simulates the air-to-air threats and tactics of adversaries to provide high-quality training to frontline pilots, best preparing them for their global operations.

Another Typhoon unit, No 12 Squadron was re-established on July 24, 2018, to train Qatari Emiri Air Force (QEAF) personnel on the type. For three weeks in late November/early December last year, the RAF Coningsby-based squadron participated in Exercise Epic Skies III at Al Udeid, Qatar. According to the squadron's OC, Wg Cdr Chris Wright, it provided the unit with a chance to fly alongside the newly formed QEAF Rafale cadre. He said at the time: "The first QEAF pilots and ground crews are progressing well on their Typhoon training courses with sister squadrons and this training has allowed us to confirm our preparations are on track for their arrival." Training of QEAF personnel began in January.

With such an operational tempo – not to forget No 29 Squadron, the Typhoon OCU, training personnel – is it enough to have six operational squadrons manning the three QRAs as well as Operation Shader and NATO commitments? Air Cdre Bradshaw concluded: "While the Typhoon Force is certainly working hard, it meets the requirements currently set against the RAF. In line with defence priorities and defence tasks, we have to make sure we have a balanced portfolio. It's not just about the air capabilities, but defence as a whole."

Speaking to *AFM* earlier this year, Air Cdre Mark Chappell, commander of the RAF's Typhoon Force, confirmed that further expansion of the force was under study. Once No 12 Squadron's work is complete as part of a joint QEAF squadron, it will return to the UK, re-equip with Tranche 1 jets and replicate what No IX(B) Squadron has done. Air Cdre Chappell added: "There's an option for one more [squadron], we are currently scoping the feasibility under Project Accio for an eighth frontline unit. Actually, the synergy of having eight means we can re-brigade how the force is structured – there's much more capability and flexibility in that because the way we would configure it would be very different. The two adversary squadrons would be slightly larger than the front line and they'd pick up the lion's share of the QRA task." AFM

Below: ***British F-35Bs flew from the deck of HMS 'Queen Elizabeth' in UK waters for the first time during Exercise Lightning Fury last January 28. The warship was in the North Sea conducting carrier qualifications for RAF and Royal Navy pilots from the UK Lightning Force's No 207 Squadron based out of RAF Marham.*** *Crown Copyright*

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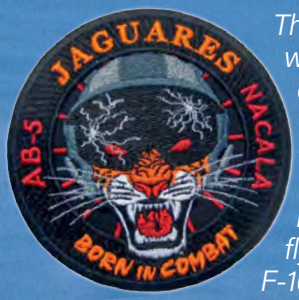
Jaguares born in combat



The 'Jaguares' squadron of the Portuguese Air Force was born in combat, its aircraft first operating over the jungles of Africa during the insurgency wars fought in Portugal's overseas possessions. ***Paulo Mata*** *charts the history of Esquadra 301, now flying the multi-role F-16AM/BM.*

Officially established on November 25, 1968, as Esquadra 502, the 'Jaguares' began operations the following January, out of Aeródromo Base No 5, in Nacala, northern Mozambique. It was the second of three Força Aérea Portuguesa (FAP, Portuguese Air Force) squadrons that would fly 40 G.91R/4 'Gina' jets (FAP serials 5401 to 5440) acquired from West Germany in 1965. The other two were Esquadra 121 'Tigres' stationed in Portuguese Guinea and Esquadra 702 'Escorpiões' at Tete in Mozambique. Their missions included counter-insurgency, battlefield interdiction, independently planned attacks and tactical reconnaissance.

The 'Gina' was thoroughly liked by air and ground crews alike, proving safe and reliable to fly and able to sustain heavy punishment under fire, while offering high availability rates with very low maintenance demands. These were all important factors in the type of wars being waged in Portugal's African colonies, as well as the G.91's ability to operate from poorly prepared runways, with the minimum of ground support (the aircraft had low-pressure tyres and a cartridge engine start-up). Nevertheless, it had a few shortcomings, notably the four 12.7mm calibre machine guns that were deemed insufficient to penetrate some targets, and the limited weight of armament carried under the wings. Insufficient radius of action and a lack of electronic countermeasures (ECM) were the other main complaints. The latter would prove especially problematic when facing man-portable surface-to-air missiles (SAMs), like the SA-7 *Grail*, which resulted in three aircraft losses and one pilot killed in Guinea. This menace had to be countered with the adoption of appropriate tactics, which eventually proved to be very effective.

Until the end of these conflicts, the combined G.91 fleet across all three squadrons accumulated around 13,000 combat sorties and roughly 20,000 flying hours, with a further two aircraft being lost due to anti-aircraft artillery (AAA), also in Guinea.

Revolution and evolution

The colonial conflicts came to an end after the coup of April 25, 1974 – known as the 'Carnation Revolution' – which ended the dictatorial regime in Portugal. The 'Jaguares' were disbanded at Nacala and then reorganised at Base Aérea No 6 in Montijo, just across the Tagus river from Lisbon.

The re-established squadron received additional pilots and aircraft from the other 'Gina' units in the soon-to-be ex-colonies and was renumbered as Esquadra 62 (at the time, the FAP squadron numbering system was derived from the air base number). Despite maintaining the jaguar as its name and symbol, it was essentially the successor to all three former Africa-based G.91 squadrons.

The G.91 played an important role in the period immediately after the Carnation Revolution, overflying rebel military units in a show of force during the failed pro-communist countercoup of November 25, 1975. Although the 'Gina' didn't fire a shot in anger,

Peace Atlantis F-16s

Portugal joined the F-16 'club' in July 1994 when its first four jets arrived at Monte Real, in the municipality of Leiria, under the Peace Atlantis I programme. They were among 20 new-build aircraft (17 single-seaters and three twin-seaters) equipped with Pratt & Whitney F100-PW-220C engines taken from USAF stocks, thoroughly inspected and updated to -220E specification.

These aircraft were to F-16A/B Block 15 Operational Capability Upgrade (OCU) standard, configured ready for the Mid-Life Update (MLU), as well as the Falcon Up and Falcon STAR structural improvement programmes. A new unit, Esquadra 201 'Falcões', was established at Monte Real to receive this first batch of 'Vipers'.

Under Peace Atlantis II, Portugal bought a second batch of F-16s in 1998, comprising ex-USAF aircraft that had been stored at the Aerospace Maintenance and Regeneration Center in the Arizona desert. Twenty-five were acquired, but only 16 F-16As and four F-16Bs entered service, the remainder being cannibalised for spares. Esquadra 301 'Jaguares' was re-formed at Monte Real to operate them.

The FAP then turned its attention to the MLU process, but it progressed slowly and Esquadra 301 only became operational with the F-16AM/BM in November 2005, with Esquadra 201 receiving its full complement of upgraded jets in 2010.

Nine F-16AMs and three F-16BMs have since been sold by Portugal to Romania, with deliveries commencing in September 2016. A contract for another five F-16As modified by Portugal to F-16AM standard was signed with Romania in January 2020 and deliveries are due to begin this year.

***Above:** F-16AM serial 15101 (AA-01, FMS 93-0465) carries a pair each of the CATM-120C-5 AMRAAM and CATM-9L Sidewinder captive air training missiles, plus an AN/AAQ-28 Litening G4 targeting pod on the starboard side of the air intake and two 370-gal drop tanks. **Below:** A hardened shelter at Base Aérea No 5 in Monte Real in central Portugal, the current home station of the 'Jaguares'. The FAP has two F-16 fighter squadrons based at Monte Real, which remain on national quick reaction alert (QRA) standby 24 hours a day.* All photos Paulo Mata unless stated

it served to discourage the rebels and help preserve the country's new-born democracy.

In 1976 the FAP began receiving the long-awaited G.91R/3 version equipped with 30mm cannon, again from West Germany, but by now too late for combat use in Africa. The 'Gina' fleet was expanded by the new G.91R/3s (FAP serials 5441 to 5474) plus 11 G.91T/3 twin-seaters (FAP 1801 to 1811). Although a further 52 airframes had been transferred to Portugal by the end of 1982, they never flew in FAP colours, instead serving as spare-parts donors.

The G.91 fleet received a few upgrades while in Portugal, mainly addressing communications and navigation systems, a new gyroscope and gunsight and even provision to carry AIM-9 Sidewinder air-to-air missiles. The AAMs were principally used in the period when the squadron had to fulfil air policing roles, after the withdrawal of the F-86F fleet, and before the arrival of the more modern A-7P Corsair II.

Meanwhile, under the new FAP system, the squadron was renumbered as 301 (which ▶

it retains to this day), in which the first digit corresponds to the squadron's main task, '3' signifying ground attack. During the 1980s, the 'Jaguares' flew another 55,000 hours on the G.91, for an overall total of 75,000, but the type's increasing obsolescence led to its phase-out in 1993, when the squadron transitioned to the Alpha Jet – another aircraft provided by Germany.

Alpha Jet period

The Portuguese Alpha Jet fleet consisted of 50 A-models, received in 1993 as payment for the German Luftwaffe's use of Beja air base in the Alentejo region, to where Esquadra 301 relocated, sharing the aircraft with Esquadra 103. The latter unit was charged with advanced flight training and used the Alpha Jet to replace its previous T-38 Talons.

The Alpha Jet brought the long-awaited passive and active ECM, among other new and improved capabilities – including a greater endurance – while maintaining the G.91's core roles of close air support, battlefield interdiction and tactical reconnaissance.

While integrating with the NATO Augmentation Force for the Mediterranean area, the 'Jaguares' participated in several international exercises during the 1990s, including Dynamic Mix 97 (hosted in Italy), Strong Resolve 98 (Portugal), Dynamic Mix 98 (Turkey), Central Enterprise and Polygonne (Germany) in 1999, Linked Seas (Portugal), Dynamic Mix (Greece) and EOLO (Spain) in 2000 and Clean Hunter (Germany) in 2001.

The Alpha Jet A was highly prized by its pilots, but there were some difficulties in operating the fleet, mostly due to a shortage of spare parts. The FAP was entirely dependent on a single supplier for some components, since the German-origin airframes were incompatible with the French-made Alpha Jets.

Once Portugal received a second batch of F-16s – which were to be modernised to Mid-Life Update (MLU) standard in concert with the other European Participating Air Forces (EPAF) – the 'Jaguares' became the FAP's second Fighting Falcon unit.

In November 2005 – just after passing the

Above: A jaguar's head was painted on the tail of F-16AM serial 15133 (M17-17/61-629, 83-1076) for NATO Tiger Meet 2007. Part of Peace Atlantis II, the jet is seen manoeuvring against the backdrop of the Serra da Estrela, the highest mountain range in continental Portugal. Below: Preparing for a night flight during a TACEVAL detachment to Aeródromo de Manobra No 1 (AM1) at Ovar, one of the FAP's reserve air bases. TACEVALs ensure the unit is ready for assignment to NATO's Quick Reaction Force.

Right: Acquired under the Peace Atlantis I programme, F-16AM serial 15104 (AA-04, FMS 93-0468) at Aeródromo de Manobra No 3 (AM3) at Porto Santo, on the archipelago of Madeira.

milestone of 20,000 flying hours on the Alpha Jet – Esquadra 301 phased out the aircraft and relocated to Base Aérea No 5 in Monte Real. With receipt of a fourth-generation fighter, the unit gained important new capabilities: night-vision goggles (NVGs), targeting pod, Joint Helmet Mounted Cueing System (JHMCS), precision-guided ordnance and beyond-visual-range (BVR) missiles.

Since then, the squadron has accumulated 27,000 flying hours in the air defence, all-weather (ADX) and fighter-bomber, all-weather – precision (FBX-P) roles. Along with Esquadra 201 – the other FAP 'Viper' unit – the squadron also assumed Portugal's quick reaction alert (QRA), a task also fulfilled during detachments under NATO's Baltic Air Policing programme (four times). The 'Jaguares' have also flown QRA during the air policing mission in Iceland and have made two deployments to Romania (2015 and 2017) and one to Poland (2019) under the alliance's Assurance Measures. Periodically, Esquadra 301 assets are also allocated to NATO's Quick Reaction Force, which requires it to accomplish a series of tactical evaluations (TACEVALs).

As part of the EPAF, the FAP's F-16s attend the Fighter Weapons Instructor Training (FWIT) school in the Netherlands, where instructors keep the 'Viper' squadrons up to date with the latest combat tactics and procedures. The squadron regularly hosts and participates in major international exercises including Trident Juncture, Frisian Flag, Joint Warrior, Tactical Leadership Programme (TLP), and others. AFM

NATO Tigers

The 'Jaguares' first participated in the NATO Tiger Meet in 1978, as observers, shortly after the squadron's reorganisation in the aftermath of the colonial wars, as it sought full integration with NATO standards and the Cold War order of battle. The following year, the 'Jaguares' became full members of the NATO Tiger Association and in 1980 a group of its battle-experienced pilots won the coveted Silver Tiger trophy for the first time. While flying the G.91, the 'Jaguares' won the trophy again in 1985, then hosted the exercise at Montijo in 1987.

In the Alpha Jet era, Esquadra 301 held the Tiger Meet twice in Beja (1996 and 2002), before appearing for the first time with its new F-16s at Albacete, Spain, in 2006. In the following years, full participation became more sporadic, mostly due to budget cuts enforced by the economic restrictions of the late 2000s. Nevertheless, the last two full participations were crowned with the Silver Tiger trophy (2011 and 2019), for a 100% success rate in the last decade.

Following commemorations of the 50th anniversary of the 'Jaguares', the squadron was scheduled to host the NATO Tiger Meet once again this year, between May 10 and 22. Rather than its home base of Monte Real, the exercise was due to be held at Beja, which is capable of supporting far more air assets. An airshow and additional spotters' days were all anticipated, before the COVID-19 outbreak saw the Tiger Meet postponed until May 2021.

Specially marked F-16AM serial 15105 (AA-05, FMS 93-0469) takes off from Mont-de-Marsan, France, during last year's NATO Tiger Meet.

***Above:** Alpha Jet A serial 15250 wearing the 'Jaguares' livery applied for the NATO Tiger Meet in 2002. In 1993, the Alpha Jet replaced G.91s assigned to Esquadra 301 and the T-33s and T-38s of Esquadra 103.* Esquadra 301 ***Above left:** The G.91R/3 flight line at Base Aérea No 6 in Montijo, with Lisbon in the distance. After the reorganisation of the FAP in the aftermath of the African wars, the G.91 fleet received three different camouflage schemes, the last two being visible on the first two jets in this line-up.* Esquadra 301 ***Below:** F-16AM serial 15105 was armed with live AIM-120C AMRAAM and AIM-9L Sidewinder air-to-air missiles during the Baltic Air Policing detachment to Lithuania in 2014. Portuguese F-16s also undertook the BAP mission in 2007, 2016 and 2018.*

Italy's nightri

Overhaul of the Aeronautica Militare (AM, Italian Air Force) search and rescue and combat search and rescue (SAR and CSAR) fleets began in 2012 with introduction to service of the HH-139A and continues today with deliveries of the new HH-101A Caesar helicopter. The first two HH-101As were delivered in mid-2015, initially being taken on charge by the Reparto Sperimentale di Volo (Flight Test Department) for check flights and to establish technical procedures for the new machine. In February 2016, in a brief ceremony at Cervia air base – home of the 15° Stormo (15th Wing) – the AM officially accepted its first four HH-101As, from an order for 12 plus three options.

The HH-101A has been developed and produced by Leonardo Helicopters (formerly AgustaWestland), to meet an Italian defence ministry requirement for a highly specialised CSAR and personnel recovery (PR) helicopter, replacing the ten-tonne-class Agusta-Sikorsky HH-3F Pelican fleet. The new rotorcraft, which was named Caesar, is a high-tech derivative of the 15-tonne-class AW101 that was already in service with the Italian Navy. The Caesar features more powerful engines, updated systems and equipment tailored for national missions as well as deployments abroad, including in high-threat environments.

In today's real-world scenarios, CSAR and PR missions have a considerable influence not only on the success of the operation itself, but also on the morale of military and civilian personnel called to serve out of area; they also have a direct impact on public opinion. In recent decades, Italy's armed forces and civil organisations have been active in many of the world's 'hottest' theatres, including Afghanistan and Iraq. Moreover, Italy's mountainous territory and long coastal boundaries often require helicopter intervention to aid people in distress. As a result, the air force places particular emphasis on rescue missions.

Nowadays, PR activities typically involve the recovery of military, diplomatic or civilian personnel, who may or may not have specific training. The mission ranges from simple recovery of endangered non-military personnel, medical evacuation, SAR over sea or land, all the way up to CSAR. The spectrum of activity within PR also includes the following specific missions:

- Insertion/extraction of special forces
- Unconventional assisted recovery (UAR) – personnel recovery assisted by special forces
- Non-combatant evacuation operation (NEO) – on behalf of diplomatic personnel
- Maritime or land-based conventional SAR

iders

The Italian Air Force is in the midst of a modernisation programme for its search and rescue and combat search and rescue units, as ***Mauro Finati*** *and* ***Paolo Rollino*** *discovered on a visit to Cervia in the northeast province of Ravenna.*

Above: ***Italian Air Force HH-101A MM81867 '15-04' during a training mission close to Cervia air base. This helicopter is still in Mission Basic configuration and will be brought up to the latest standard during its next overhaul. A portion of the black HH-101A fleet will be repainted in the new grey colours after this upgrade work.*** *Mauro Finati* ***Below:*** ***The HH-101A's state-of-the-art glass cockpit is equipped with five large (8 x 10in) displays, is fully NVG compatible and the pilots are provided with helmet-mounted displays with head trackers.*** *Paolo Rollino*

- Humanitarian relief operations (HRO)
- Medical evacuation (medevac) and casualty evacuation (casevac)

Within the Italian Air Force, PR operations are the responsibility of the Cervia-based 1ª Brigata Aerea 'Operazioni Speciali' (1ª BAOS, 1st Special Operations Air Brigade). This includes four wings: the 9°, 15°, 16° and 17°; of these, the 9° and the 15° are flying units. The squadrons tasked to fly the Caesar are the 21° Gruppo (part of the 9° Stormo) at Grazzanise air base near Caserta in southwest Italy and the 23° Gruppo (15° Stormo) at Cervia; both are former fighter units, previously operating the F-104S Starfighter, Tornado F3 or F-16A/B.

The 15° Stormo received a first batch of six HH-101As in so-called Mission Basic configuration to allow transition training before the first Mission Enhanced examples were delivered last year. The main difference between the two is the advanced operational equipment in the later version, including an active self-protection suite, latest-generation ▶

***Above:** When a slow-flying light aircraft is detected and intercepted, the HH-101A approaches from the side. The Caesar crew displays the 'follow me' sign in the window and escorts the aircraft to a safe area.* *Mauro Finati*

forward-looking infrared (FLIR) and other advanced electronic systems. The six Mission Basic HH-101As will be retrofitted to the full standard over the course of time.

The introduction to service of such a complex machine is a lengthy process. The 15° Stormo was tasked to form an initial cadre of crews to act as instructors; they were drawn from both the 9° and 15° Stormo. Instructors were selected with flying experience ranging from the modern HH-139A to the older HH-3F and HH-212A. Many have valuable operational experience; attached to the 9° Stormo is the 21° Gruppo, based at Grazzanise, still flying the HH-212A (AB212ICO). Crews belonging to this unit have gained valuable experience in CSAR and special forces operations during several tours of duty in Afghanistan. For those coming from the old 'analogue' helicopters such as the Pelican or Twin Huey, transition to the fully digital and much more capable Caesar has been quite a challenge. The 21° Gruppo officially received its first Caesar last December 21 and, at the same time, the 909° Gruppo Efficienza Aeromobili, the 9° Stormo's maintenance unit, received certification to carry out routine work on the new helicopter.

Family tradition

Leonardo has a long history of developing SAR helicopters for the armed forces. From the 1960s, the company – then named Agusta – produced Sikorsky's SH-3D/H and HH-3F under licence and these saw extensive use by both the Italian Navy and the air force. More recently, the firm has acquired considerable experience producing SAR-configured AW101s for the military market, delivering all-weather, long-range versions for Canada, Denmark and Portugal. At its UK plant in Yeovil, Somerset, the company is currently producing and delivering 16 AW101s to meet the challenging Norwegian All-Weather SAR Helicopter (NAWSARH) requirement. This technological know-how has been put to good use in developing the Caesar.

The first HH-101A made a maiden flight at Yeovil on March 19, 2014, in the presence of the then Italian Air Force chief of staff Lieutenant General Pasquale Preziosa and other dignitaries. In the words of one 15° Stormo crew member: "The Caesar looks like an AW101, but it's actually a completely different machine compared with those already in service."

The Caesar is based on the Merlin Series 400 architecture – the utility version of the AW101; the specific model is identified as the Series 600 or Merlin Mk611. The airframe meets the highest safety requirements, including a crashworthy structure and transmission with a 30-minute run-dry capability. It's powered by three General Electric CT7-8E (T700) engines each rated at 2,500shp (1,884kW) at maximum take-off power; the HH-101A has a 15.6-tonne maximum take-off weight, can reach a maximum cruise speed of 277mph (446km/h) and has a range of around 870 miles (1,400km) on internal fuel only.

The Caesar's main rotor has five large composite blades of distinctive shape; they ensure the helicopter is notably quiet during flight and reduce the problem of decreased visibility when landing in dusty or snowy areas. The advanced rotor-blade design creates a pocket of low turbulence within the rotor radius, while most of the downwash is redirected far beyond the blade tips. This also helps to facilitate winch-recovery operations or fast-roping. The main rotor blades and tail boom can be folded for stowage aboard ships during naval operations.

The helicopter's PR role requires it to operate autonomously in extreme environments and in any meteorological conditions. In this broad mission spectrum, the Caesar's particular operational niche covers 'covert' missions – known as Supporto Aereo alle Operazioni Speciali (SAOS, air support in special operations). These are typically of a joint or multinational context and flown in hostile areas. For moving casualties, the Caesar is equipped with a medical treatment module, searchlight, dual rescue hoist, cabin floor protection (Jigsaw's Sea Tray system) and stretcher racks.

In addition to its core PR missions, the Caesar

Caesars going grey

Above: Delivered last January 21, MM81873 '15-12' is the tenth HH-101A for the AM and the first with the new light grey colour scheme. On February 20, a second grey Caesar arrived at Cervia. The last example from the current order is due for delivery by the end of the summer. *Mauro Finati*

The HH-101A was originally provided with an infrared-absorbent matt black paint scheme optimised for operations at night. However, last January 29, the 15° Stormo at Cervia received the ninth HH-101A, MM81873 '15-12', wearing a new light grey colour scheme. This supersedes the previous livery, which proved prone to deterioration in normal operating conditions, especially in Italian summer weather. The last three remaining helicopters are scheduled to be delivered before the end of the summer. Thereafter, it's possible that a mixed grey/black fleet will be maintained and operated.

***Left:** The port-side gunner frames his target (an HH-139A) in the sights of the Dillon M134D machine gun during a slow-mover interception training mission. The Caesar's machine gun operators are provided with ballistic protection.* Paolo Rollino
***Below:** The Caesar can be armed with three Dillon M134D 7.62mm machine guns, one each on the right- and left-hand sides and one in the rear position. This last gun is hung from the ceiling and can be easily moved up from its firing position to leave the rear ramp free.* Paolo Rollino

has also been deployed in the slow-mover interception (SMI) role against potential low-flying threats, during official events such as the Jubilee of Mercy in Rome (2015-16) and the G7 Summit in Taormina, Sicily (2017).

The HH-101A can accommodate up to five crew members plus 20 fully equipped troops, or six crew plus eight troops, ensuring maximum flexibility for special operations. It can be armed with three Dillon M134D 7.62mm calibre Gatling-type machine guns installed one each on the right and left sides and one on the rear ramp. This rear gun hangs from the cabin roof and can be moved up from its firing position, leaving the rear ramp free for embarking/disembarking bulky cargoes or small vehicles. The cockpit seats are armoured to increase ballistic protection for the pilots and additional armoured plates are provided for the machine gun operators and for critical systems.

An integrated electronic warfare system provides self-protection against radar, laser and infrared threats. The helicopter features large aircraft infrared countermeasures (LAIRCM) and ELT/572 directional infrared countermeasures (DIRCM) systems. Based on the Israeli Elbit Systems MUSIC system, the ELT/572 DIRCM is a joint project between Italy's Elettronica and Elbit's ELOP subsidiary.

For long-range operations, the Caesar features an air-to-air refuelling (AAR) kit, enabling joint missions with assets such as the AM's KC-130J. The HH-101A is the first Italian helicopter to be refuelled in flight and the first European rotorcraft to perform AAR at night, using night-vision goggles (NVGs). The helicopter can be configured for different missions, with removable equipment including the armament, refuelling probe and stretchers.

The Leonardo Airborne and Space Systems (A&SS) division was responsible for a number of the Caesar's sensors, communication and self-protection systems, including radios, identification friend or foe (IFF), crypto, Link 16, intercommunications system, advanced laser warning receiver (LWR) and a missile launch detection system (MILDS). The A&SS division also furnished the Gabbiano multimode synthetic aperture radar; in addition to the standard air-to-surface search modes using track-while-scan (TWS), this offers an inverse synthetic aperture radar (ISAR) mode, providing high-resolution images in sub-metric wavelength, enabling classification of intercepted targets. In ground moving target indicator (GMTI) mode, the Gabbiano can detect moving targets over land. The HH-101A also features an L3 CSW VORTEX data link; this allows real-time data exchange between the helicopter's sensors and remote sources such as satellites, drones and other aircraft. The incoming data can be used by the crew or by special forces operators to keep abreast of the tactical picture of the target area during the flight itself.

***Left:** HH-101As and HH-139As share the ramp at Cervia. The smaller HH-139As maintain a rotational standby alert together with the other Italian SAR centres, ready to scramble if needed.* Mauro Finati

Top: ***Defensive fire in the area behind the helicopter is the task of the gunner in the rear position: with the ramp open they can keep watch for any potential threats. The Caesar's large cabin can accommodate up to 20 equipped soldiers or a medical team plus stretcher patients.*** *Paolo Rollino* ***Above:*** ***Armed with three 7.62mm machine guns and comprehensive on-board systems, the HH-101A is considered one of the most advanced CSAR helicopters. The FLIR sensor under the nose is useful for searching for targets in low-light conditions.*** *Mauro Finati* ***Above right:*** ***Thanks to its three powerful CT7-8E engines, the HH-101A is relatively agile for a helicopter of its size. The advanced rotor-blade design creates an area of low turbulence within the rotor radius, facilitating winch recovery operations or fast-roping.*** *Mauro Finati* ***Below:*** ***The first Caesar produced for the Italian Air Force, MM81864 '15-01' is ready to taxi for take-off. The HH-101A is covered with dielectric panels and antennas for communication and self-protection systems, while the nose houses the multimode search and rescue radar.*** *Paolo Rollino*

Flight deck

One of the Caesar's key features is the advanced NVG-compatible glass cockpit including five large multifunctional displays (MFDs), which provide superior situational awareness for the crew. As well as the 10in x 8in (254 x 203mm) MFDs, the avionics include a synthetic vision system, digital map, integrated mission console and mobile phone. Pilots are provided with helmet-mounted displays with head trackers. The integrated avionics suite consists of a four-axis automatic flight control system (AFCS), traffic collision avoidance system (TCAS), helicopter terrain awareness system (HTAWS), proximity detection system, TETRA radio communications system, mission recorder, direction-finding and automatic identification systems (AIS), satellite communications (SATCOM) systems and a Leonardo A&SS laser obstacle avoidance system (LOAM). The LOAM is a navigation aid for low-level flight and can detect obstacles as small as power cables and provide terrain mapping along the flight path.

The main recipient of the air force's SAR assets is the 15° Stormo, home-based at Cervia. At the end of the first decade of the 2000s, the AM planned the progressive withdrawal of its HH-3F and HH-212A fleets and the adoption of new helicopters as part of a reorganisation of the entire SAR system. The AgustaWestland AW139 (HH-139A) and AW101 (HH-101A) were chosen and at the end of 2010 a contract was signed for the purchase of 13 and 12 respectively. Options for another three Caesars have not yet been exercised, but a follow-on purchase of 17 more HH-139As has been approved, for a total of 30, allowing the establishment of one, or perhaps two, new SAR centres.

Centre of excellence

Recognising the AM's particular capability in the area of PR, the European Air Group (EAG) has given it responsibility to manage the European Personnel Recovery Centre (EPRG). In July 2015, the EPRG became active at Poggio Renatico in northeast Italy, with the aim of standardising PR activities across the European armed forces.

Today, the Caesar crews are heavily involved in a training programme aimed at fully exploiting the operational capabilities of their sophisticated helicopters. Following a building-block approach, they are completing training modules focused on specific mission elements such as basic helicopter manoeuvring, combat manoeuvring, weapons employment, surface-to-air threats and advanced air integration. AAR sorties are often performed, especially at night, in co-ordination with the C-130J crews based in Pisa, operating in a dedicated area over the central Adriatic Sea. At least twice a year, usually in March and October, one or two helicopters and several crews are detached to Decimomannu in Sardinia for range activities such as firing the M134, chaff and flare release or testing surface-to-air missile evasion tactics.

Most recently, HH-101As from the 15° Stormo – supported by crews from the 9° Stormo – have carried out bio-containment transport of Italian citizens infected with the COVID-19 virus. Operating across national territory out of Cervia from March 6, the Caesar has been outfitted with the Aircraft Transit Isolator (ATI) – special insulated stretchers for transporting highly infectious patients. AFM

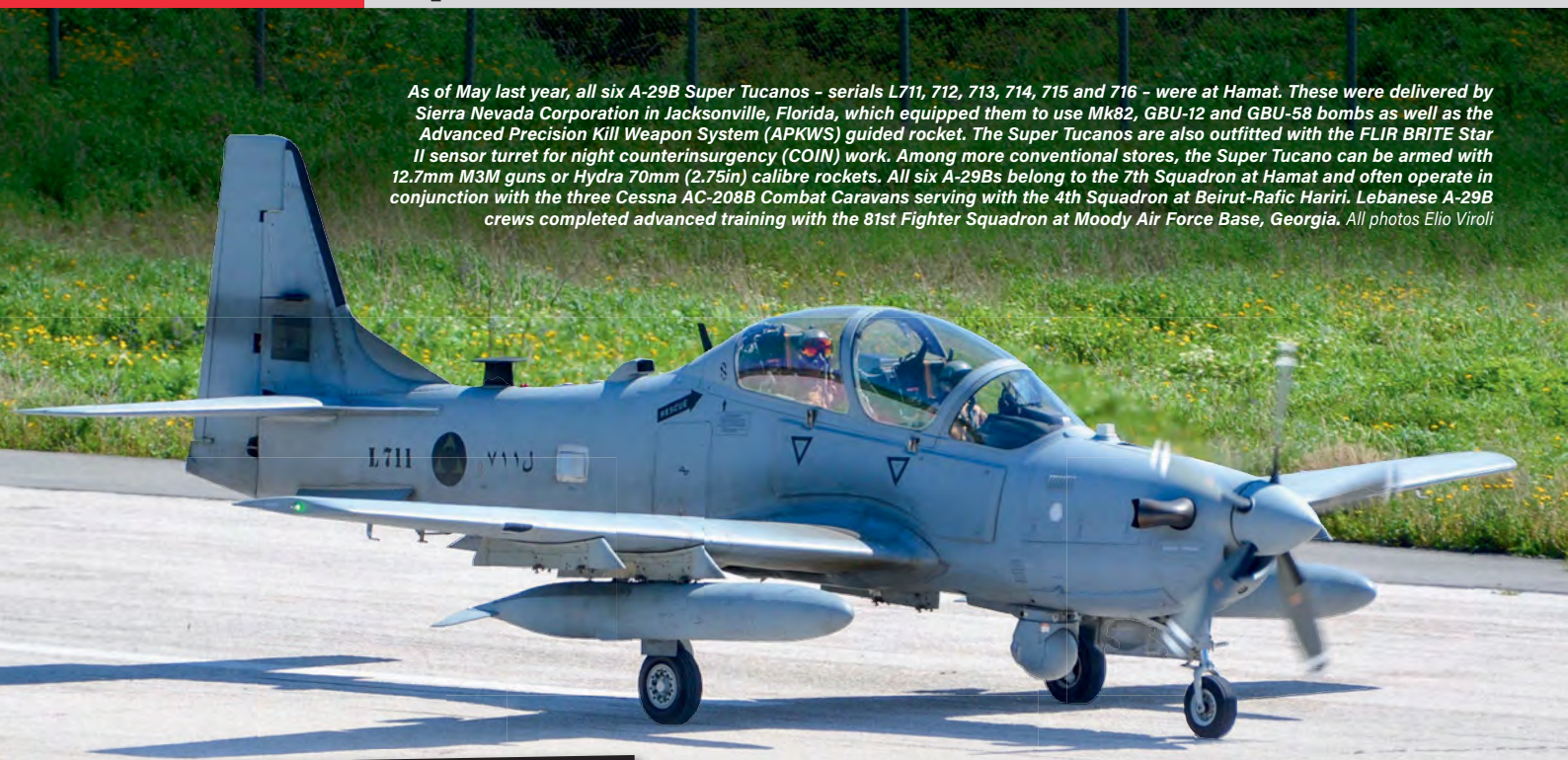
15° Stormo

The 15° Stormo – motto 'Ab Coelo In Auxilium Vitae' (From the skies, saving lives) – has a complex structure, with flying units spread across Italy. On October 5, 2010 the unit was transferred from Pratica di Mare, near Rome, to Cervia and its controlling authority – the 1ª BAOS – has been based there since 2014. The 15° Stormo command and all major support structures are located at Cervia, together with a rotary-wing logistics centre.

The wing controls several flying units, including the 81° Centro Addestramento Equipaggi (CAE, 81st Crew Training Centre), based at Cervia and in charge of training pilots, on-board operators and air rescue personnel. It operates HH-139As and HH-101As assigned as required from the logistics unit, the 915° Gruppo Efficienza Aeromobili (GEA, 915th Aircraft Maintenance Squadron). The operational unit at Cervia is the 83° Gruppo SAR (83rd SAR Squadron) with three HH-139As assigned.

The other flying units reporting to the wing are: the 80° Centro SAR at Decimomannu, Sardinia, which still flies the HH-212A; the 82° Centro SAR at Trapani-Birgi, Sicily; the 84° Centro SAR at Gioia del Colle in southeast Italy; and the 85° Centro SAR at Pratica di Mare – the last three all fly the HH-139A. Each SAR centre also has a single TH-500B for liaison tasks, except the 84° Centro SAR, which has two.

The first six HH-101As (as well the next Mission Enhanced aircraft) were delivered to Cervia, where they were flown by the 81° CAE followed by the 23° Gruppo 'Veltri' (23rd Squadron 'Greyhounds'). Plans to redeploy the 23° Gruppo to Istrana – where it would be integrated with the 51° Stormo – have never been confirmed, and the General Staff is also considering other locations. Meanwhile, the 21° Gruppo at Grazzanise is now also being equipped with the Mission Enhanced Caesar. While the 23° Gruppo is primarily tasked with PR roles (with special operations as a secondary task), the 21° Gruppo is mainly involved in special operations support (with secondary PR roles).



As of May last year, all six A-29B Super Tucanos – serials L711, 712, 713, 714, 715 and 716 – were at Hamat. These were delivered by Sierra Nevada Corporation in Jacksonville, Florida, which equipped them to use Mk82, GBU-12 and GBU-58 bombs as well as the Advanced Precision Kill Weapon System (APKWS) guided rocket. The Super Tucanos are also outfitted with the FLIR BRITE Star II sensor turret for night counterinsurgency (COIN) work. Among more conventional stores, the Super Tucano can be armed with 12.7mm M3M guns or Hydra 70mm (2.75in) calibre rockets. All six A-29Bs belong to the 7th Squadron at Hamat and often operate in conjunction with the three Cessna AC-208B Combat Caravans serving with the 4th Squadron at Beirut-Rafic Hariri. Lebanese A-29B crews completed advanced training with the 81st Fighter Squadron at Moody Air Force Base, Georgia. All photos Elio Viroli

Postcard from Lebanon

AFM contributors Elio Viroli and Stenio Bacciocchi provided these photos from a trip to the three main bases of the Lebanese Air Force at Hamat, Rayak and Beirut-Rafic Hariri. This air arm was established in 1949, six years after the country gained independence from France. In the past, the LAF had to rely solely on a helicopter force but, in recent years, three AC-208B Combat Caravans were acquired for reconnaissance and attack and, in May 2018, the country received the last of an initial six A-29B Super Tucanos.

Above: *The IAR-produced IAR-330SM Puma is the 9th Squadron workhorse at Hamat. The helicopter is used in the attack role with SNEB 68mm (2.68in) calibre rockets, as well as adapted 30mm Aden guns. However, one of the type's major tasks is search and rescue in both the mountains and at sea; serial L916 is equipped with skis for mountain SAR work. Also seen at Hamat were Pumas L914 and L917. The first of four Pumas donated by the United Arab Emirates arrived in Lebanon in April 2010. A second batch of three followed suit by late September that year, while a final three were still awaiting dispatch from the UAE as of May 2011 and are not thought to have been delivered.*

Left: *Still on the apron at Beirut-Rafic Hariri is Sikorsky S-61N AD-1603, flown in the past by the resident 16th Squadron. This aircraft was withdrawn from use around a year ago after an intensive period of service as a VIP transport, as well as for firefighting. The first of three secondhand examples acquired from UK-based Absolute Fire Solutions was handed over to the LAF in May 2009 and was formally accepted in an official ceremony in June. The other two examples were delivered in June and July 2009 respectively.*

***Left:** Bell UH-1H-II Huey II serial L1206 of the 12th Squadron at Rafic Hariri air base, which is located on the north side of Beirut's international airport. The LAF operates UH-1Hs in two different colour schemes and two different versions, including the latest Huey II, which will soon replace the 'legacy' UH-1H fleet. In July 2012, the US Defense Security Cooperation Agency notified US Congress of a possible Foreign Military Sale of six Huey IIs to Lebanon, valued at around US$63m. Although no firm order was announced in public, all six were delivered to Lebanon in December 2012. Bell Helicopter was awarded a contract in March 2016 for a further three Huey IIs, which were delivered the same month.*

***Above:** The historic air base at Rayak is the oldest in Lebanon and is home to UH-1Hs, as well as the R44 Raven II – serial L-1505 seen here. The R44 is currently used by the 15th Squadron, which is assigned to the air force's training school. Other Raven IIs present at the time of the visit were serials L-1504 and L-1506. A batch of four examples was delivered in 2005 and 2006, but one was damaged as the result of a forced emergency landing in November 2010 and is believed to have been repaired. Rayak's training facility also accommodates UH-1Hs – serial L1004 was noted. **Above right:** Cessna AC-208B Combat Caravan serial L-402 was the sole example present at Beirut-Rafic Hariri. The three armed Cessnas are used by the 4th Squadron in the COIN role and work in co-operation with the A-29Bs. In December 2008, local sources reported that the US government had offered Lebanon three Combat Caravans, configured for intelligence, surveillance and reconnaissance (ISR) tasks, with AGM-114 Hellfire missiles to conduct precision strike missions. A first Cessna 208B was delivered in April 2009, but in a standard, unarmed configuration. Delivery of a secondhand, fully equipped AC-208B took place in August 2013 and the first example was then upgraded by Alliant Techsystems Inc (ATK) to the same configuration. The third AC-208B was handed over in Beirut in December 2016.*

***Above:** Rayak-based SA342L Gazelle serial L815 is one of a few examples still in use with the 8th Squadron as trainers. In the past they served in an attack role, armed with 30mm Aden gun pods. Lebanon received an original seven Gazelles in 1980, all of which were withdrawn on receipt of nine more examples donated by the United Arab Emirates in 2007. Attrition losses occurred on June 20 and August 28, 2008, the latter when the pilot was mistakenly shot and killed by a Hezbollah gunman. Another Gazelle was damaged in a forced landing on December 3, 2010. **Left:** Scottish Aviation Bulldog Series 126 serial L145 at Rayak. This veteran trainer is still in use with the 1st Squadron. Six Bulldogs were delivered in 1975. An attrition loss occurred in 1983 and the five survivors were retired from service in 1993, then offered for sale in 2000. No sale materialised and it is believed that two were destroyed on the ground during Israeli air strikes. Local sources reported that the three survivors were to be restored to an airworthy condition by late 2010. In July that year, it was confirmed that the aircraft had returned to service.*

Acknowledgements *Thanks to General B Ghassan Fadel, Lebanese Military Attaché in Rome.*

Uzbekistan Air Force

Uzbek air power

Anthony Pecchi *provides a spectacular photo report from the little-known and rarely seen Uzbek Air Force.*

Above: A 'Fulcrum' pilot strikes a heroic pose in front of his fully armed mount. Note the 330-imp gal (1,500lit) drop tank fitted under the fuselage. Limited range was always the Achilles heel of the first-generation 'Fulcrum', so the 9.13 introduced internal fuel tanks with a capacity increased by 53 imp gal (240lit), plus the option to carry two additional 253-imp gal (1,150lit) fuel tanks under the wings. Left: Since the withdrawal of its Su-27 fleet, the spearhead of the Uzbek Air Force has been provided by the MiG-29, which serves in single-seat 'Fulcrum-C' and two-seat 'Fulcrum-B' derivatives. These single-seat izdeliye 9.13 'fat-spined' MiG-29s each carry a pair of B-8 rocket pods on the inner underwing hardpoints. They entered series production in 1986 and became the most widespread MiG-29 variant. An L-203 Gardenia-1 electronic jammer is fitted inside the curved top of the fuselage decking. All photos Anthony Pecchi

Photo Report

Uzbekistan Air Force

These 'Fulcrum-Cs' carry a full load of air-to-air weapons: a pair of R-27R (AA-10a 'Alamo') missiles on the inner underwing pylons plus four R-73s (AA-11 'Archer'). The R-27R has a combined guidance system – the seeker employs inertial navigation with mid-course radio corrections during the first 30 seconds of flight, then uses semi-active radar guidance for the terminal phase, which requires illumination of the target by the fighter's radar. Equipped with an all-aspect infrared seeker, the R-73 is the standard Russian close-air combat missile and remains one of the best in the world for this purpose.

Left: 'Up periscope' for a two-seat Su-25UB (Uchebno-Boevoi or combat trainer). The 'Frogfoot-B' retains a full combat capability, including the twin-barrel 30mm GSh-2-30 fixed cannon built into the port side of the forward fuselage, below the pilot's cockpit, and provided with 250 rounds. Uzbekistan is currently working hard to become more autonomous in terms of training and maintenance. Below: Two 'Fulcrum-Cs' unleash 80mm rockets against targets on the range. MiG-29s and Su-25s carry these unguided rockets in streamlined B-8M launchers, each carrying 20 examples of the 80mm (3.15in) calibre S-8 rocket. This family of rockets includes the S-8KO and S-8KOM with shaped-charge/fragmentation warheads, while the S-8B and S-8BM versions have sub-calibre warheads for penetration of concrete constructions and the S-8D and S-8DM versions are armed with a thermobaric warhead.

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Uzbek Su-25s armed with B-8 rocket pods head towards the firing range. Single-seat 'Frogfoot-A' and two-seat 'Frogfoot-B' combat trainers received this overall grey paint scheme after a recent overhaul. The ground-attack aircraft's eight main wing hardpoints are each able to carry a 1,102lb (500kg) load, while two small outboard pylons are available for R-60 (AA-8 'Aphid') air-to-air missiles. A normal weapon load amounts to 2,954lb (1,340kg), comprising four 250kg (551lb) bombs plus two R-60 AAMs.

***Above:** Backbone of the heavy-lift transport fleet is the Il-76MD, which can carry up to 105,822lb (48,000kg) of cargo in its pressurised freight hold. Alternatively, the cargo compartment can accommodate 167 troops (245 when a second deck is installed) or 126 paratroopers; the latter disembark via the rear hatch in four rows, as well as doors on both sides of fuselage. As well as paratroopers, military equipment can be dropped from either high altitude or as low as 10-16ft (3-5m) above the ground, in which case the load is extracted using a small parachute. **Above right:** This weather-beaten Mi-8MT is among the air arm's helicopter force inherited from the Soviet Union. The 'Hip' is fitted with armour panels around the cockpit and a nose-mounted, single-barrel A-12,7 12.7mm calibre machine gun in the NUV-1MK nose turret, fired from the flight deck, which has a rate of fire of 1,400 rounds per minute. Pods for 80mm rockets are carried on the outrigger pylons. **Below:** Heavier rocket armament is available in the form of the S-24, which arms both the Su-25 seen here and the MiG-29. The S-24 is a veteran unguided rocket that entered Soviet service back in 1961. The 240mm (9.45in) calibre weapon is carried individually on a rail launcher.*

Photo Report

Uzbekistan Air Force

Left: High-speed nap-of-the-earth flying from AS532AL Cougar '208'. Uzbekistan ordered an initial batch of these helicopters – already battle-proven in Africa and Afghanistan – and all had been delivered by 2016. The Cougars fly logistic and close air support missions and the armed forces were so satisfied with this first batch of helicopters that they ordered a second consignment in April 2018. The helicopters are fitted with powerful weapons: 70mm (2.75in) rockets and 20mm gun pods, while the second batch added the Nexter SH20 door-mounted 20mm gun. The Cougars are also equipped with a Sagem Euroflir electro-optical/ infrared turret.

Above left: An Uzbek Mi-24P 'Hind-F' in its element, low over the foothills. Uzbek helicopter crews are well trained, with a high level of expertise. They are reportedly the only troops in the region able to fly and fight both day and night, using night-vision goggles (NVGs). The Mi-24P (izdeliye 243; P for Pushechnyi or cannon) was based on the Mi-24V gunship but with a fixed twin-barrel 30mm GSh-30K cannon on the starboard side of the forward fuselage. The GSh-2-30 was designed specifically for the Su-25 and was later adapted for the Mi-24P in the GSh-30K version. The rate of fire is 3,000 rounds per minute. Above right: Nearest the camera is H125M Fennec '105', one of ten examples that entered service from 2014. Next in line is AS532AL Cougar '205'. In the early 2010s, Uzbekistan decided to modernise its ageing helicopter force. The 'hot and high' operations typical of the country required strong and reliable helicopters, so the military turned to the Airbus Helicopters range, signing a first contract in 2013 for both the Cougar and Fennec. The H125 (then called the AS350B3e) was already famous in Uzbekistan for having landed on Everest, the ultimate reference in high-mountain operations! Uzbekistan's H125s are mainly used for training and light surveillance work, but can also be armed with 7.62mm calibre machine guns. Below: A pair of C295Ws cavort for the camera. C295W '01' was the initial example destined for the Uzbek Air Force. It was first noted undertaking a test flight from Seville in June 2015. All four of these transports had been delivered by May 2016.

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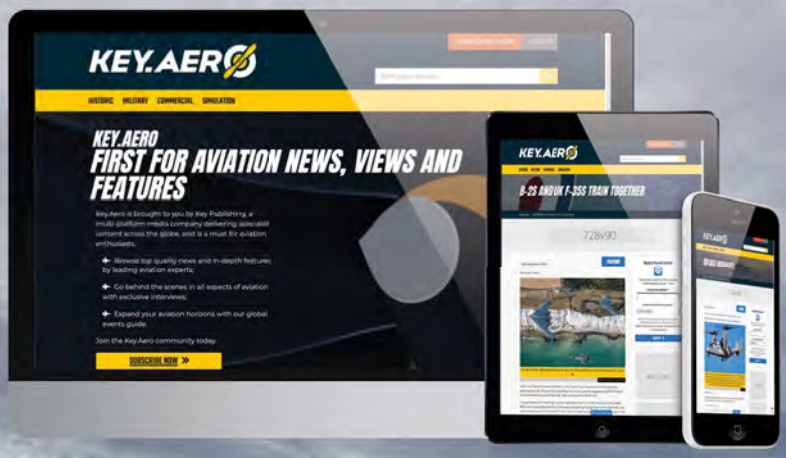

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Airlifters in Africa

AFM travelled to Niger and Mali to meet and fly with British, French, German, Spanish and US air units involved in the war against terror. In the first part of this feature, ***Jean-Marc Tanguy*** *joins the international operations in Mali.*

1: One of the three Chinooks operated by the RAF in Mali, at Gao last December. Due to the long ranges involved, the RAF detachment in Mali primarily uses 'fat-tank' Chinook HC5s, like ZH904 seen here. Thought has been given to using the HC6A, but it would require internal tanks for most missions. 2: Inside an RAF Chinook travelling between Gao and Gossi at the end of December. The French Army's chief of staff, Général Thierry Burkhard, a former commando in the Legion Étrangère's (French Foreign Legion's) 2e Régiment Étranger de Parachutistes (2e REP), was among the passengers. 3: The view from the Chinook's open rear ramp. The weapon system operator (WSOp) is ready to open fire with a 0.3in calibre machine gun. 4: Since mid-December last year, a Danish helicopter detachment, including around 70 personnel, has been deployed on the French-led Opération Barkhane. Here, a pair of EH101 Merlin Mk512s are used to transport freight and soldiers. This is serial M-507 from the Royal Danish Air Force's Eskadrille 722 normally based at Flyvestation Karup. *All photos Jean-Marc Tanguy unless stated* ***Patch:*** *James Lawrence*

Our story starts in Gao, central Mali, where the French military has its most important base in the Sahel region: 2,000 men and women in the centre of a powder keg. Jihadists – known in French as groupes armés terroristes or terrorist armed groups – affiliated with both al-Qaeda and the African branch of so-called Islamic State (IS) regularly attack the town and the base, using suicide bombers or rockets. Three RAF Chinooks belonging to Operation Newcombe have been based at Gao since July 2018. Newcombe is the codename given to the deployment of RAF Chinooks to support the French operation in Mali with what the UK Ministry of Defence describes as "niche logistics capabilities."

Mali is one of the hardest environments imaginable for the Chinook, with high temperatures, dust and rocks. The rotor blades can be worn out much quicker than elsewhere, and one engineer is dedicated to surveying the status of each blade after every flight. Despite the challenges, the British detachment commander told *AFM*: "Availability rate is very high and no-fly days are uncommon." He didn't provide more specific figures but remarked: "Our mechanics are magicians, to get the Chinooks ready to fly in such a hard environment." The airframes, as well as the rotor blades, are at permanent risk of strikes from the plentiful Malian stones.

Each Chinook stays in Gao for up to nine months, before going back to the UK on board an RAF C-17. To operate the three helicopters, four Chinook crews of six personnel each are involved in Operation Newcombe at any one time. The flying teams remain in theatre for three-month periods.

The French appreciate the Chinook as a 'flying Swiss Army knife' that can fly the combat-equipped 4x4 Toyotas used by commandos from the 11e Brigade Parachutiste (40 operators deployed in Mali) and the 27e Brigade d'Infanterie de Montagne, a mountain infantry brigade (50 operators). But the rotorcraft are also used to bring these soldiers ammunition, fuel and water, often transporting supplies into the middle of nowhere. The commandos perform a function similar to the British Long Range Desert Group (LRDG) of World War Two, searching for and confronting the enemy during ten-day patrols. The Chinooks are also used to transport infantrymen between Gao and Niamey in Niger (the air port of disembarkation – APOD – for all of the western Sahel) and the forward operating bases (FOBs) around Gossi, Ménaka, Kidal and Tessalit in Mali.

A total of 94 British personnel, including six women (two of whom are flying engineers), bring their flexibility and esprit de corps to the contingent in West Africa. They come from 23 different units and, at the time of *AFM*'s visit in February, were led by No 18 Squadron from RAF Odiham, Hampshire. The team leader, an OF-4 (wing commander), has plenty of experience with expeditionary assignments, including previous deployments to Northern Ireland, Iraq, Afghanistan and Kenya.

As of the end of February, 1,870 flight hours had been logged, transporting 12,207 passengers and 987 metric tonnes of supplies over the course of 585 missions. Average flying hours are 94 per month.

Trip to Gossi

Together with the French Army Chief of Staff, *AFM* had the opportunity to fly from Gao to Gossi and back last December 27.

Gossi is the main destination for the RAF

Chinooks and they have helped establish an entire FOB there. Prior to this, no airstrip was available in the vicinity and the alternative road route was littered with improvised explosive devices (IEDs). At the time of *AFM*'s visit, more than 200 sorties had been flown there in support of French efforts to fight the jihadists.

During the flight to Gossi, the Chinook was escorted by a Gazelle from the Aviation Légère de l'Armée de Terre (ALAT, French Army Aviation). On other occasions, ALAT Tigres are also required to accompany the Chinooks.

The British helicopters fly with two Miniguns, plus a 7.62mm machine gun on the rear ramp. They also carry flares to defeat shoulder-launched surface-to-air missiles. Some of these weapons have been found by French special operations forces (SOF) during search-and-destroy missions.

The British wing commander continued: "Mali is such an expansive country and the distances so incredible that the Chinook is well suited for French needs." The powerful Chinook can move an entire platoon at a time, which is a clear advantage over the French helicopters, which can rarely fly with more than 15 troops in the cabin. As well as being able to carry as much as three Pumas, two Cougars or two Caïmans, the Chinook has extremely long legs, thanks to its fuel capacity. Furthermore, once on the ground, it can deliver fuel for up to five Tigres from 1,100gal (5,000lit) tanks.

British involvement in Mali was decided upon during the United Kingdom-France Summit at the Royal Military Academy Sandhurst in July 2018. The mission had been scheduled to end this June but the French defence ministry recently confirmed the Chinooks will stay in Gao beyond that date. France clearly appreciates the heavy-lift helicopters and there are plans to deploy a British quick reaction force to eastern Mali this year, too.

International presence

Gao is also home to two Flyvevåbnet (Royal Danish Air Force) EH101 Merlin Mk512s that arrived there last December. In future, there are plans to make them part of Task Force Takuba, a European SOF unit that will bring together Belgian, Danish, Estonian and Swedish assets and teams. The Swedish are expected to arrive with around 150 operators plus helicopters (NH90 or UH-60M). The eventual aim is for Takuba to include around 450 people, as well as rotorcraft and unmanned aerial vehicles (UAVs). Initial operational capability is scheduled for this summer, with full operational capability in early 2021. This force will train, assist and accompany Malian troops in the fight against terrorists, in the same way that NATO units did in Afghanistan using embedded training teams (ETT) and operational mentoring and liaison teams (OMLT). A full French helicopter unit is also deployed in Gao with five NH90 Caïmans, two Cougars, five Tigres, and four Gazelles, as well as a single-fixed-wing PC-6. The Gazelles are split into two configurations: the Viviane with a roof-mounted sight and HOT missile capability, or a sniper version. With helicopter performance limited by the hot conditions, only two missiles can be carried on the Viviane. The sniper configuration incorporates a COSE STRIKE lateral arm to carry the rifle. This version was developed in concert with two SOF units, the 1er Régiment de Parachutistes d'Infanterie de Marine (1er RPIMa, a French equivalent to the British SAS, their antecedents having been trained by David Stirling during World War Two) and the 4e Régiment d'Hélicoptères des Forces Spéciales (4e RHFS, a dedicated SOF rotorcraft unit with 40 aircraft).

Among the Caïmans and Cougars, two or three examples are kept on medical evacuation (medevac) alert. They're mainly used with commandos from the 27e Brigade d'Infanterie de Montagne that are embedded with the rotary unit. The Tigres are primarily employed for their 30mm gun, which has been used with impressive results. Two Pumas will join the unit in the coming months to improve airmobile efforts; they will be transferred from the French detachment in Djibouti, in the Horn of Africa.

Fixed-wing fleet

An Armée de l'Air (French Air Force) CN235 is on hand at Gao for medevac duties. It can land on unpaved runways and is often scrambled to transport injured military personnel of various nationalities from Mali to Niamey in neighbouring Niger, where the air force has a 450-strong base. Medevac-equipped Falcon 900 or 2000 aircraft land there and take the injured back to France. Using this method, an injured soldier can be in a NATO-certified Role 2 hospital within an hour (the famous 'golden

Operation Newcombe Chinook detachment composition

Category of rank	Number
OF-4	1
OF-3	2
OF-2	10
OF-1	3
OR-9	3
OR-7	1
OR-6	13
OR-4	18
OR-2	43
Total personnel	**78 RAF, 16 British Army (including six women)**

***Left above:** The German Luftwaffe has two C-160Ds deployed in Niamey, Niger. This example – 50+77, equipped with countermeasures for self-defence – was noted on the French part of the base at Gao. **Left:** The single Malian Republic Air Force C295W, TZ-11T, at Gao last February. Airbus Defence and Space announced in February 2016 that Mali had ordered a single winglet-equipped C295W and the transport commenced its delivery flight in December the same year. **Right:** The Aviation Légère de l'Armée de Terre contingent at Gao comprises five NH90s, two Cougars, four Gazelles and five Tigres. This line-up includes a pair of NH90s and a Tigre.*

Above: ***One of the 17 A400M Atlas transports now belonging to the Escadron de Transport 1/61 'Touraine' waits for the green light from the control tower at Gao.*** *Left:* ***The Spanish Air Force C295M (T.21) has an integrated self-protection system that's always used in Mali, where aircrews face the threat of shoulder-launched surface-to-air missiles. The operating unit is Ala 35 from Madrid-Getafe, which supports transport of troops and material in Mali under Tactical Air Detachment 'Ivory'.***

hour') and back in France within 24 hours.

Travelling to Niamey, *AFM* flew aboard an Ejército del Aire (EdA, Spanish Air Force) C295M. Since 2013, the EdA has permanently deployed one C-130H and one C295M in West Africa to support French troops. One is based in Dakar, Senegal, and the other in Libreville, Gabon. The aircraft are fitted with a full set of defensive flares for self-protection and an escort team of air force paratroopers armed with FN Minimis and G36 assault rifles is ready to help in case of an emergency landing in hostile areas.

Other foreign contributors to Barkhane – the codename of the French operation in the Sahel – include the US and Germany. US Africa Command (AFRICOM) offers live imagery from intelligence, surveillance and reconnaissance (ISR) assets based in the region, including armed MQ-9 Reapers based in Niamey and at Agadez in Niger. Other US air assets include a KC-135R temporarily based in Spain and one or two C-130Js that come to Niamey for short periods and are used to transport French troops between there and Gao. The Hercules are from the 86th Airlift Wing at Ramstein Air Base in Germany, the nearest USAF transport base.

Germany is involved in the UN Multidimensional Integrated Stabilization Mission in Mali (MINUSMA) and has two Transalls in the Sahel region, one permanently configured for medevac. Under federal law, a German soldier engaged in overseas operations must have the same level of medical support they would receive in Germany. The medevac Transall can carry patients to the German Role 2 hospital in Niamey, from where a dedicated asset from Germany can fly them home. In addition, Germany has a Heron I UAV in Gao, mainly used for force protection duties. Last February, Germany's Kommando Spezialkräfte (KSK, Special Forces Command) also deployed four H145Ms plus commandos for a mission in Niger, where the focus is on training the local SOF; this is the first H145M mission in the area. As well as the regular Transalls, the Luftwaffe also uses its A400Ms for support flights to and from the region.

Private contractors

Additional air assets in the Sahel region are provided by private contractors. US forces make use of a Twin Otter, plus an H225 and Bell 214ST helicopter to provide tactical transport and medevac in Niger. French forces have access to a pair of Beech 1900Ds for travelling within the five countries covered by the Opération Barkhane anti-insurgent campaign: Burkina Faso, Chad, Mali, Mauritania and Niger. Two Mi-8s add to the tactical transport capability, delivering freight, with a capacity of 2.5 tonnes each; the availability of the *Hips* allows military assets to focus on tactical missions. Other private aircraft include an An-26 from the French Daher company based in Gao and other twin-engine fixed-wing types operating across the wider region.

For strategic transport, the French HQ uses an An-124 heavy airlifter. In mid-March, one example transported 15 4x4 Toyotas for Barkhane commandos. The same type also carries urgently required outsized freight, such as helicopters. **AFM**

French attrition in the Sahel

Since they began in West Africa in 2010, French anti-terror operations have resulted in many accidents and mishaps. A 4e RHFS Gazelle was damaged by gunfire over Mali on January 11, 2013, and was destroyed on the ground by SOF commandos. The same day, another Gazelle was hit and its pilot, Lt Damien Boiteux, was the first person to be killed in action during Opération Serval, which started on that date. A Tigre suffered 26 impacts from ground fire in 2013, and another was destroyed after a mid-air collision with a Cougar last November 26, killing 13 commandos and the pilots.

A 4e RHFS Caracal was destroyed during a night landing while training in Burkina Faso on November 29, 2014; one member of the crew was killed. In February 2016, a Gazelle was also lost during night landing training at Madama FOB in northern Niger.

Last June 14, a Gazelle was destroyed by enemy fire with one 27e Brigade d'Infanterie de Montagne commando on board. All three personnel were injured, but the commando managed to attach the two pilots to the side of an incoming Tigre for immediate extraction; the Gazelle was then destroyed on the ground with explosives.

An An-26 operating under contract for the French SOF was lost in the Côte d'Ivoire during a landing mishap in Abidjan in April 2017. Four members of the crew were killed, but two crew members and four passengers, among them SOF commandos, survived.

Two French Air Force Mirage 2000s have also been lost. On June 9, 2014, a Mirage ran out of oil en route to Niamey and the crew ejected. They were on the ground for 75 minutes before being rescued by a team of 27e Brigade d'Infanterie de Montagne commandos. A subsequent operation was launched to recover the aircraft from the hostile area. Another incident occurred when a Mirage 2000NK3 aborted its take-off from N'Djamena in Chad on September 27, 2017. Last July, a French Air Force CN235 was damaged on the ground in Chad while an army team practised firefighting.

Many other aircraft have been damaged by storms, including a CN235 in Chad, plus Pumas and a Tigre in Mali.

Coming up

In future issues of AFM, *Jean-Marc Tanguy will report on the Armée de l'Air strike force in Niamey and French SOF air operations in the Sahel.*

Israel's 'Mighty

The Israeli Air Force was the first F-35 operator to expose the type to combat and is looking forward to receiving a dedicated flying testbed as it adds more indigenous equipment to the stealth fighter. Meanwhile, as **Arie Egozi** explains, Israeli industry has an eye on picking up increased workshare now Turkey has departed the programme.

If the foreign sources regularly quoted in the Israeli media are to be believed, in recent months Israel has performed a number of very long-range attacks against Iranian targets in Syria using its new F-35I Adir ('Mighty One' in Hebrew). Key objectives include facilities operated by Iran for the upgrade of battlefield rockets destined for Hezbollah insurgents in Lebanon.

While the frontline F-35I is gaining combat experience, the Israeli Air Force (IAF) has prepared a list of additional weapons and other "functional" systems that it intends to demonstrate on a specially configured F-35A test aircraft. This testbed – serial 924 (c/n AS-15, FMS 15-5232), a sub-variant of the Israeli F-35I – has been manufactured according to IAF specifications and took two years to prepare. It made its maiden flight from Fort Worth, Texas, on March 4 and is scheduled to be delivered later this year (see *Dedicated Israeli trials F-35A makes first flight*, May, p21). It will be operated by the IAF's Flight Test Centre, also known as MANAT (its acronym in Hebrew) and previously designated as 601 Squadron, at Tel Nof Air Base, south of Tel Aviv. The unit undertakes aircraft and weapons trials, avionics integration and airframe modification and testing.

The aim of the special aircraft is to adapt Israeli-developed systems to the IAF's operational F-35Is, with the Flight Test Centre working to enhance the capabilities of the Adir in both air-to-air and air-to-ground missions. An officer from the centre told *AFM*: "All our platforms have been upgraded to enable expansion of the flight envelope while using the unique weapon systems made by Israeli industries."

Since the first two examples of the stealth fighter aircraft arrived at Nevatim Air Base, southeast of Be'er Sheva, in December 2016, some locally made systems have been trialled in different scenarios. But only when the test aircraft arrives can this experimental work be performed to its full extent. According to the

Ones'

Specially configured F-35A serial 924 (AS-15, FMS 15-5232) is due to be delivered to Israel later this year and will serve with the IAF's Flight Test Centre at Tel Nof Air Base. It will be used for continued aircraft and weapons trials, avionics integration and airframe modification and testing. *Henry B Ham*

IAF, because the F-35 is a fifth-generation aircraft, all the planned upgrades are "directly connected" to the special maintenance programme required for this stealth aircraft.

Some of Israel's defence industries have been busy adapting operational systems for use on the F-35I. These include electronic systems and weapons that meet the operational requirements of the IAF. These initial designs have since been updated based on the operational experience accumulated with the aircraft so far. Israeli sources say the Rafael SPICE 1000 standoff missile will be carried by the F-35I, as part of a range of Israeli-developed weapon systems that will eventually be carried by the stealth fighter.

The case for more F-35s

The importance of the F-35I to the IAF is very clear. However, since last year, a heated debate has continued around the question of whether to purchase another 25 of the stealth jets or to delay this purchase and channel the budget for the immediate acquisition of a new squadron of advanced-variant Boeing F-15s.

After a long internal debate, on February 18 Israel Defense Forces (IDF) general staff decided to purchase another F-35I squadron and one of F-15 Israeli Advanced (F-15IA) jets, in a deal estimated to be worth US$4bn. The decision reflects the scope of missions the IAF will have to deal with in any major confrontation, especially one involving Iran. Sources in the defence ministry said that acquisition of the two types will have to be performed using "creative funding" as there is currently no budget for a parallel purchase. One option would be an initial buy involving smaller numbers of each type, while another would prioritise one type before acquiring the other.

According to sources close to the issue, while the F-35I performs best on missions for which stealth is essential, in later phases of combat there's a requirement for other aircraft with advanced avionics, that can operate in conjunction with the Adir and carry heavy weapons loads. Israel has developed a variety of such weapons and the source said: "We need a 'heavy truck' for these systems."

Proponents of the purchase of additional F-35Is also pointed to its capability to gather and share intelligence. One source told *AFM*: "With the threats Israel faces, this capability is essential."

Last year, the IAF's F-35Is participated in a large-scale exercise and proved their capability to serve as 'target generators' for other fighters. The Blue Flag manoeuvres at Ovda Air Base in the Negev desert involved around 70 aircraft – including, for the first time, F-35s from both Israel and Italy.

One of the primary scenarios envisaged for the F-35I is attacking targets protected by Russian-made S-300 and S-400 long-range surface-to-air missiles (SAMs). Last year, the F-35I participated for the first time in an exercise involving this mission profile. Conducted in co-operation with ground forces, the exercise simulated "war in several arenas simultaneously, with the focus being on the northern arena." This is a euphemism for potential conflict involving Syria and/or Iran. According to the IAF, the air arm is getting ready to deal with advanced anti-aircraft systems, namely the Russian-supplied S-300 SAMs deployed in Syria.

While the earlier S-300 is now operational with regime forces in Syria, the IAF did not explain why the exercise also featured simulated areas protected by the more advanced S-400, which has been purchased by Turkey. One explanation may be based on Ankara's declaration that it might deploy the S-400 near its border with Syria. Israeli sources said that the S-400 may be rushed to the area "under certain circumstances" and this is the reason IAF

***Left:** Israeli Air Force F-35I serial 927 (AS-18, FMS 17-5326) from 140 'Golden Eagle' Squadron. This was the 17th example to be delivered to the service together with the 18th, serial 928, in September last year. Initial operational capability was declared in December 2017.* *IAF* ***Below:** Wearing the insignia of 140 'Golden Eagle' Squadron on the engine intake, Adir 927 takes off from Ovda Air Base to participate in a training mission during Exercise Blue Flag on November 5, 2019. This was the first deployment of Israeli F-35Is at a base other than their home station of Nevatim.* *USAF/Airman 1st Class Kyle Cope*

Above: ***An Adir pilot engages full afterburner from the Pratt & Whitney F135 engine, which can deliver more than 40,000lb of thrust. While IAF doctrine prizes the F-35I's stealth characteristics for 'day one' operations in highly contested airspace, it also recognises the need for a 'heavy truck' able to carry large weapons loads.*** *Amit Agronov*

Adir deliveries

In October 2010, the Israeli defence ministry signed a letter of offer and acceptance (LOA) for the F-35, becoming the first overseas customer to receive aircraft via the US Foreign Military Sales (FMS) programme. Acquisition of an initial 50 F-35I Adir jets was approved by the Israeli government.

Two F-35Is were ordered under the eighth batch of low-rate initial production (LRIP 8, Fiscal Year 2014). Seven more followed under LRIP 9 (FY2015), six under LRIP 10 (FY2016) and at least six were added under LRIP 11 (FY2017), for a total of 21. Each of LRIP 12 (FY2018), LRIP 13 (FY2019) and LRIP 14 (FY 2020) were expected to contain six aircraft for Israel.

The initial cadre of Israeli pilots began training at Eglin Air Force Base, Florida, in early 2016. The first F-35I was unveiled at Fort Worth on June 22, 2016, and took its maiden flight on July 25. The second aircraft flew for the first time on August 8, 2016.

Delivery of the first two aircraft to Nevatim Air Base took place on December 12, 2016. Three more followed in April 2017, a further pair in September and two more in November. The F-35I achieved initial operational capability in December 2017, at which point nine aircraft were in the country.

Deliveries in 2018 comprised three in June 2018, while aircraft AS-13 and AS-14 followed in November. Aircraft AS-16 and AS-17 were delivered in July 2019, followed by AS-18 and AS-19 in September and AS-20 and AS-21 in November. Twenty aircraft have now been delivered to Israel, to equip two squadrons at Nevatim Air Base – 116 'Lions of the South' and 140 'Golden Eagle' – while the 21st aircraft, AS-15, is the dedicated test aircraft that took to the air last March.

F-35I Adir serial 911 touches down at Lajes in the Azores for a fuel and crew rest stop on November 6, 2017, after arriving from the Lockheed Martin factory in Fort Worth, Texas. It was part of a pair – 911 and 913, callsign 'Retro 51' flight – that arrived at Nevatim two days later. *André Inácio*

pilots are being trained to operate against it.

The sources added that the threat posed to the gas reserves in the Mediterranean has the potential to cause "major confrontations". Israel is pumping gas from these reserves, making them a potential target for Hezbollah, the Shia Islamist political party and militant group based in Lebanon.

Another scenario involves the IAF suppressing missiles mainly launched by Hezbollah in Lebanon. This organisation's armed wing has an arsenal of around 140,000 rockets, some with very heavy warheads. According to Colonel A (full name withheld on security grounds) from the IAF: "The enemy is capable of launching big salvos of rockets. Our mission is to strike even before a single rocket is launched."

During the recent large-scale exercise, the F-35I made use of undisclosed "different systems" aimed at increasing the lethality of the stealth fighter. The drill was carried out with participation of aircraft from combat squadrons, helicopters and transports, plus ground-based air defence systems.

During the manoeuvres, the F-35I also demonstrated one of its main advantages – its capability to collect real-time intelligence and disseminate it to many 'clients', including other aerial platforms. In recent years, the IAF has invested in heavily in such data-dissemination systems.

Major General (ret) Eitan Ben Eliyahu, former commander of the IAF, told *AFM* that the F-35 will add two main capabilities to the service: "Stealth is one major capability, especially in our region where enemy countries are operating huge numbers of ground-to-air weapons. The

second capability is the one that allows this aircraft to receive and distribute all kinds of combat data from a long list of sensors. This is very important for an air force that is performing combat missions almost continuously."

To date, Israel has signed contracts for 50 F-35Is and the plan is to buy an additional 25. This will match the desired size of the Adir fleet when the IAF initially decided to buy the stealth fighter. As well as adding F-15IAs, the IAF plans to upgrade its existing fleet of F-15I Ra'am strike fighters to the same standard, adding to the budget burden.

The Turkish equation

After the cancellation of Turkey's F-35 deal as a result of Ankara purchasing Russian-made S-400 SAMs, it's worth looking at the possible implications of this, which extend far beyond the question of whether Turkey can remain a NATO member long-term.

The full scope of the ramifications is unclear, but some factors are already very obvious. First, Russia has announced that it is ready to supply its advanced Sukhoi Su-35 fighters to Turkey now it's no longer in the F-35 programme. Sergey Chemezov, head of the Rostec State Corporation, told Russian news agency Sputnik that Turkey's President Recep Tayyip Erdoğan would consider buying the Russian fighter aircraft: "If our Turkish colleagues express interest, we are ready to supply them with Su-35s."

Turkish officials told reporters in Ankara that local industries could experience temporary economic losses due to the decision to remove Turkey from the F-35 programme, but promised that they would eventually be strengthened. Turkey had a requirement for more than 100 Lightning IIs and indigenous companies were involved in manufacture of the stealth fighter.

Despite the officials' optimism, Turkey looks set to suffer big losses as a result of its decision. There are also early signs that Ankara will try to make up for these by advancing local defence programmes. Last November, President Erdoğan said the locally made fifth-generation TF-X fighter would be ready for flight in the next five or six years. This is a highly ambitious timeline, a fact that local defence industry analyst Turan Oğuz admitted to pro-government *Daily Sabah* newspaper: "The domestic projects and the modernisation of existing F-16 jets will strengthen Turkey's air capacity. But in times of urgent need, if the Turkish [Air Force] deems necessary, the country can also look for alternatives abroad."

A closer look at the Türk Hava Kuvvetleri (THK, Turkish Air Force) reveals a problematic picture. The air arm currently operates 239 F-16 fighters of various sub-types, but only half of these are thought to be at full combat readiness. In recent years, the THK has been forced to transfer increasing numbers of F-16s to storage due to a lack of pilots - dozens of aviators were arrested following the failed coup attempt in 2016.

In June last year, the US House of Representatives agreed to a non-binding resolution outlining a number of potential courses of action involving increased sanctions against Turkey. According to the draft resolution: "In addition to the F–35 Joint Strike Fighter, Turkish defence acquisition programmes that could be affected by sanctions include the Patriot air and missile defence system [not yet delivered to Turkey], CH-47F Chinook heavy-lift helicopter, UH-60 Black Hawk utility helicopter, and F-16 Fighting Falcon."

Blue Flag 2019 was the first time Israeli F-35Is had taken part in an international exercise, and they used the Link 16 data link system in conjunction with NATO aircraft, including Italian F-35As. As with other Joint Strike Fighter operators, Israel identifies the F-35's sensor fusion and data-sharing capabilities as a key advantage in the modern battlespace. *IAF*

If the US actually implements a spare parts embargo on the Turkish F-16, the air force will only be able to keep flying if its maintenance plants are allowed to 'cannibalise' other aircraft and use their parts to service the rest.

According to Israeli sources, the situation has the potential to reignite the defence ties between Turkey and China. In recent years, these relations were relatively low key but, in the past, it looked like both countries were headed towards closer defence co-operation.

Professor Uzi Rabi is the director of the Moshe Dayan Center for Middle Eastern and African Studies in Tel Aviv. He said there's no doubt that Erdoğan will now strengthen relations with China: "He knows that the Chinese have a very multi-target policy. They attach military help with economic interests and Turkey will have to consider it and accept it." Rabi said that renewed relations between Turkey and China would also harm Washington's goals in its trade war with China.

F-35 fallout

Turkish industry was supposed to manufacture close to a thousand different parts for the F-35, with eight Turkish companies contracted to supply components to the programme. Meanwhile, ten Israeli companies are supplying sub-assemblies and electrical parts for the Joint Strike Fighter. The major supplier is Israel Aerospace Industries (IAI), which has opened a production line for F-35 wings.

Israeli sources say that some of the work that was supposed to be done in Turkey will instead go to other countries that have already signed contacts to buy the F-35, but the vast experience of the IAF and the capabilities of local defence industries may work in their favour. Israeli industries are now trying to evaluate how much additional work they could receive. AFM

Recent reports from Israel suggest the Israel Defense Forces general staff favour a purchase of Advanced F-15s, seen here, as well as additional F-35Is. A deal for the F-15IA would likely be accompanied by an upgrade of the existing 25-strong F-15I Ra'am fleet to a similar standard. *Boeing*

A Russian S-400 SAM system is dwarfed by the capacious hold of an An-124 transport. In Turkish hands, this weapon system has emerged as a particular source of concern for Israeli defence planners, especially if it is deployed near Turkey's border with Syria. *Russian MoD*

B-2, or not B-2?
21st-century bombers

In World War Two, the long-range bomber emerged as one of the most potent symbols of air power. But the dawn of the strategic missile threatened the manned bomber's primacy and, as Air Power Association President, **Air Marshal (ret'd) Greg Bagwell CB CBE**, explains, today it's the payload, not the platform that really counts.

British statesman Stanley Baldwin, in 1932, used the phrase "The bomber will always get through" during a speech to the UK parliament. Prior to this, Italian general and early air-power theorist Giulio Douhet was a key proponent of strategic bombing, and as early as 1907, the science fiction author H G Wells had painted a rather dystopian vision of a world held at risk by fleets of long-range bombers in his novel *The War in the Air* – all three of them can claim to be somewhat visionary. World War Two was to see dedicated bomber aircraft striking deep into enemy territory and causing widespread fear and damage, and the two air-delivered nuclear weapons detonated over Hiroshima and Nagasaki cemented the bomber as the ultimate war machine.

Bombers in the missile age

However, in the mid-1960s a UK study suggested that the advance of anti-aircraft technology meant that the bomber *wouldn't* always get through and so the UK switched its nuclear

US Army Air Force B-17F 42-3352 'Virgin's Delight' of the 410th Bombardment Squadron, 94th Bombardment Group (Heavy), Eighth Air Force, over the Focke-Wulf factory at Marienburg, East Prussia, on October 9, 1943. World War Two cemented the basic truth of Stanley Baldwin's assertion that "the bomber will always get through" – but at a huge cost in aircrew and aircraft. *USAF*

Above: A mushroom cloud billows over Hiroshima after the detonation of an atomic bomb dropped by B-29 'Enola Gay' of the 509th Composite Group, on August 6, 1945. The photo was taken by one of the five other B-29s from the group involved in the raid. The group's heritage is maintained by the 509th Operations Group which flies the USAF's B-2A fleet. *USAF*

***Above:** A USAF B-52H powers over Prince Sultan Air Base, Saudi Arabia, last November 1. The Stratofortress, deployed from Barksdale Air Force Base, Louisiana, was part of a regular Bomber Task Force operating out of RAF Fairford, Gloucestershire. Once due for retirement in 1996, the B-52H has seen its out-of-service date pushed successively back to 2000, 2003, 2040 and now 2050.* USAF/Staff Sgt Daniel Snider

***Right:** Three Vulcan B1As of the RAF's Waddington Wing in 1957. These bombers were initially painted in anti-flash white to reflect thermal radiation from a nuclear explosion. The Vulcan – together with the Victor – was designed to carry the Blue Steel standoff missile, which was the UK's primary nuclear deterrent until superseded by nuclear-armed submarines in the late 1960s.* Crown Copyright

priorities to the submarine-based Polaris system. Slowly, the UK phased out its use of the V-bomber and switched procurement to more agile fighter-bomber types. Some nations retained their larger bombers (notably the US and Russia), but these were either reserved for more benign scenarios or were made capable of standoff strike missions through the use of cruise missiles. It may seem slightly counterintuitive to see 1950s-vintage B-52s and Tu-95s still operating today, but their niche roles and updated weaponry have enabled

***Above:** A Royal Navy Polaris missile lifts off from a land pad during a test in the US. By 1968 the first of the navy's new strategic missile submarines was on deterrent patrol. The navy officially took over deterrent operations from the RAF in mid-1969 and since then there has always been at least one missile submarine on patrol.* US DoD

"As NATO aircrew, we have all been 'teased' by Russian Bears flying just off national borders, but the reality is that those same Bears in a conflict would fire their cruise missiles from several thousands of kilometres away"

them to retain relevance in certain roles. Some nations have continued to remain loyal and develop modern bomber variants, notably the USAF which has kept on evolving, with the B-2 in service and the B-21 in development. Here, the emphasis on evolution has been on stealth in order to ensure the safety of the bomber facing an increasingly high level of threat.

So, are these advanced new modern bombers an essential part of the air power armoury, or are they merely the preserve of nations who find it hard to let go and can afford the luxury?

The case for the bomber

The primary advantage of large dedicated bomber aircraft is, and always has been, a case of physics; simply, notwithstanding more escalatory intercontinental ballistic missiles (ICBMs), it can carry the most weapons over the furthest distance in the fastest possible time, and if there were no other factors at play, all attack aircraft would be designed that way. But even in World War Two, the vulnerability of a bomber meant either a high dependency on self-defence armament (which reduced ▶

Two USAF B-1Bs, escorted by two US Navy EA-18Gs, ready to be refuelled by a pair of KC-135s operating out of Al Udeid Air Base, Qatar, last October. The bombers had flown directly from their home station of Ellsworth Air Force Base, South Dakota, demonstrating the air arm's ability to rapidly deploy strategic bombers anywhere in the world. USAF/Master Sgt Joshua L DeMotts

Commander's Update Briefing

Above: ***A Russian Aerospace Forces/Long-Range Aviation Tu-160 'Blackjack' seen from the cockpit of an intercepting RAF Typhoon from RAF Lossiemouth, Scotland, on September 20, 2018. The Tu-160 is more properly termed a strategic missile carrier than a bomber, with an armament almost exclusively made up of standoff cruise missiles.*** *Crown Copyright* ***Left:*** ***Russia's Tu-22M3 represents a class of bomber that's now absent from Western inventories – in Russian nomenclature there is a distinct differentiation between the Tu-95MS or Tu-160 'strategic bomber' and the Tu-22M3 'long-range bomber'. During the Cold War, air force Tu-22Ms would have been tasked mainly with cutting off NATO in Europe from American supporting forces.*** *Russian MoD*
Below: ***An unarmed AGM-86B Air-Launched Cruise Missile manoeuvres over the Utah Test and Training Range en route to its final target during a simulated combat mission. The ALCM had been released from a B-52H flown by the 2nd Bomb Wing, Barksdale Air Force Base, Louisiana. The Stratofortress remains the only carrier of this nuclear-tipped weapon.*** *USAF/Staff Sgt Roidan Carlson*

the bomb payload) or dedicated fighter escort was needed to protect them; even then casualties and losses were substantial.

Another vital factor at play was the accuracy of the bombing; views still differ today on the effectiveness or morals of the massed bombing raids in the 1940s. But in the more recent past, the advent of guided weapons has hugely negated the limitations of freefall weapons released with marginal accuracy from medium altitude. The use of B-52s today with large payloads of guided weapons has combined precision with mass, and continued to keep relevant a platform that's now around 70 years old. So, even mid-20th-century bombers have maintained their utility in the 21st century. With the USAF inventory of the next few decades likely to include the B-52, B-2 and B-21, just exactly what is a 21st-century bomber and who needs one?

Payload at the forefront

Well, the fundamental principles for bomber aircraft are still largely valid; delivering effect over time and distance is a formula that continues to favour the large payloads that bombers bring. Although, while mass is still relevant, precision weapons mean that today it is more about the large number of targets that can be struck by individual weapons, rather than carrying a large enough payload to negate the inaccuracy of 'area' weapons in destroying a single target. However, the generational shift occurring in weapon design means, that for the time and distance element, it is the weapon and not the aircraft that is the dominant factor. As NATO aircrew, we have all been 'teased' by Russian *Bears* flying just off national borders, but the reality is that those same *Bears* in a conflict would fire their cruise missiles from several thousands of kilometres away, immune from intercepting fighter aircraft. Defeating that threat is more about the targeting of the incoming missiles than it is the distant launch vehicle. And perhaps that phrase 'launch vehicle' goes to the nub of this argument; the standoff and speed that new weapons are increasingly capable of providing means that even old 'launch vehicles' like Tu-95s and B-52s can remain relevant today and well into the future. All that said, not all targets can be struck with ease from great distance – many targets are mobile or hard to detect and there are specific scenarios where a bomber may need to get closer to a target; however, in my view these are diminishing quickly.

So, do I think the UK or countries like it should invest in their own 21st-century bombers? Well, I can certainly see value in having the ability to launch larger numbers of smart weapons from larger platforms, but I do not see the need for an expensive, niche platform able to penetrate sophisticated enemy defences. There is merit in a debate about what can be launched from other platforms, such as a P-8 Poseidon or Voyager, or maybe there are a few old B-52s out there for sale? So, with apologies to Hamlet and Shakespeare, my answer is 'not B-2'. AFM

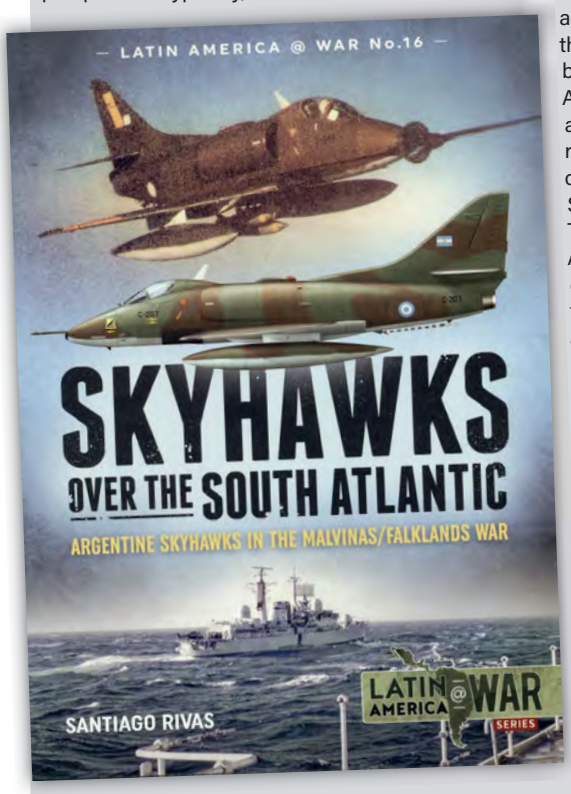
NEXT MONTH:
Aerial gunnery

Below: ***USAF B-2A crew chiefs assigned to the 509th and 131st Aircraft Maintenance Squadrons recover one of their aircraft during Bomber Task Force Europe operations at RAF Fairford, England, last March 13. US Strategic Command routinely conducts such operations across the globe to demonstrate its commitment to collective defence.*** *US Air National Guard/Tech Sgt Colton Elliott*

Skyhawks over the South Atlantic

For many years, the short and brutal air war during the 1982 Falklands conflict has been viewed mostly from the British perspective. Typically, information and reference to the air operations flown by the Argentine forces has been very limited in nature or has come from Royal Navy archives.

At last this shortfall has been addressed with this publication by renowned Argentine author and regular *AFM* contributor Santiago Rivas. The focus is on A-4 Skyhawk operations flown by the air force and navy. These jets were the backbone in the offensive that attacked the Royal Navy Task Force and British ground installations.



At the time of the conflict, the A-4 was a 30-year-old design set against the revolutionary Sea Harriers of the Fleet Air Arm. Despite the disparity in terms of capabilities, the Skyhawk pilots flew relentless strikes, often in appalling weather and at the limit of the jet's range.

This is a fascinating insight with personal accounts from aircrews and maps that illustrate their routes to the Task Force and San Carlos Bay. These are accompanied by exceptionally detailed colour profiles, each of which has an extensive caption listing the camouflage colours, weapon loads and the history of the depicted A-4.

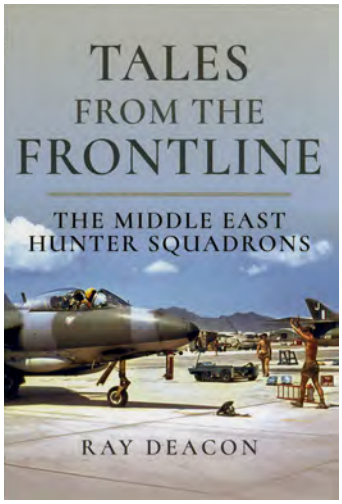
There is detailed text across all chapters, tables and lists that describe who flew each mission, and the results and fate of the aircraft. Clearly this was a labour of love for the author.

A small chapter on post-1982 Skyhawk operations concludes the best book to date on the topic. It cannot be recommended highly enough. **Glenn Sands**

Publisher: Helion & Company
Author: Santiago Rivas
Pages: 96
Price: £16.95
ISBN: 9781912866397

Tales from the Frontline
The Middle East Hunter Squadrons

Looking at the size of today's RAF, it's hard to believe that during the 1960s the service's commands stretched around much of the world.



Plenty of the squadrons operating from far-flung bases found themselves involved in limited wars, many of which never made the headlines in the United Kingdom.

One of the most active components at the time was Middle East Command, which was charged with defending the skies above Aden and its protectorates. The command and the squadrons within it spent a large proportion of their energy and resources supporting army activities in the mountains of the Aden hinterland. For the Hunter squadrons, this meant attacking dissident targets and patrolling the border with Yemen.

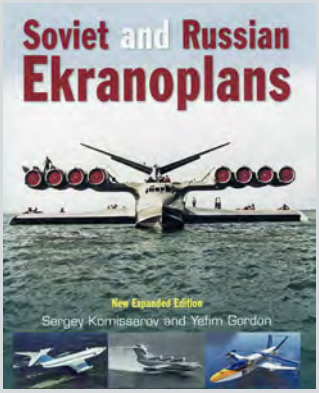
This book goes far beyond the more familiar pilot accounts. The author has cleverly interwoven personal stories from those who serviced the Hunters and supplied logistics, with his own experiences including his RAF training as a radio mechanic during the 1950s. The various anecdotes are accompanied by period photographs from personal collections.

A fascinating account into how the RAF operated at the height of its global reach. **Glenn Sands**

Publisher: Pen and Sword Books
Author: Ray Deacon
Pages: 372
Price: £30
ISBN: 9781526721464

These titles are available from: The Aviation Bookshop, 31-33 Vale Road, Royal Tunbridge Wells, Kent, TN1 1BS, United Kingdom. **Telephone:** +44(0)1892 539284 **Website:** www.aviation-bookshop.com

Soviet and Russian Ekranoplans



This new, expanded edition of what was regarded as the definitive work on ekranoplans brings the story up to date, while evaluating how the technology is being developed outside Russia. Unfortunately, with no significant military contracts from the Soviet military, the chapters that focus on the impressive eight-engine Lun and its military derivatives remain virtually unchanged.

However, the break-up of the USSR allowed the formerly secret ekranoplan technology to filter to other companies, many of which have proposed paramilitary and commercial applications for the wing-in-ground (WIG) effect vehicles. The authors have gone to great lengths to cover these new developments with comprehensively detailed chapters and technical drawings as well as assembling a collection of images unlikely to be bettered in any other publication. Military and the later commercial models proposed by the Sukhoi, Bartini and Beriev design bureaus are all included. Proposed designs featured include the Be-2500 capable of carrying a two-stage suborbital space launch system with a small space shuttle.

The authors argue that the technology has yet to reach its full potential. But many companies are wary of WIG effect craft despite the fundamentals being developed and refined over 50 years. **Glenn Sands**

Publisher: Crécy Publishing
Author: Sergey Komissarov and Yefim Gordon
Pages: 392
Price: £39.95
ISBN: 9781910809365

80 years

The term 'maestranza' dates back to the age of Spain's Catholic monarchs during the 15th century, when the first artillery pieces began to enter army service. These early workshops were dedicated to storage, distribution, repair and fabrication of artillery and ancillary equipment, or assisting naval dockyards cleaning ships' hulls and repairing naval equipment. With the advent of aviation, the first Maestranzas Aéreas were created. Their basic roles remained similar, despite the much more modern technology involved.

Throughout their history, these workshops have exchanged and disseminated information, ensuring a core group of specialists are ready to perform the MRO services required by Spain's armed forces.

Today, to optimise results, each of the three operational Maestranzas Aéreas specialises in a class of Ejército del Aire (EdA, Spanish Air Force) aircraft.

At Cuatro Vientos in Madrid, MAESMA looks after the helicopter fleet and light transport aircraft such as the C212 Aviocar (local designation T.12).

In Seville, the MAESE is responsible for heavy transports including the C-130 Hercules (T.10/TK.10), P-3 Orion (P.3), CN235 (T.19/D.4), C295 (T.21), as well as light propeller types such as the Beechcraft F33C Bonanza (E.24), Beechcraft C90 King Air (U.22) and T-35C Pillán (E.26) among others; it's also being readied to support the A400M (T.23).

Finally, within Los Llanos air base in Albacete, MAESAL specialises in MRO to support the EdA jet fleet – the C101 Aviojet (E.25), F-5M Freedom Fighter (AE.9), EF-18M and F/A-18A+ Hornet (C.15/CE.15), the Eurofighter Typhoon (C.16/CE.16) and the CL-215T/415 (UD.13/14).

Abbreviations

MAESAL	Maestranza Aérea de Albacete, Los Llanos
MAESE	Maestranza Aérea de Sevilla, Tablada
MAESMA	Maestranza Aérea de Madrid, Cuatro Vientos

Left: ***Colonel Fernando Javier Álvarez Sintes is the commander of MAESAL.*** *Rafael Treviño Martínez*

MAESAL covers more than half the EdA's fleet, including aircraft operated by ten units.

Each Maestranza also specialises in particular technologies that apply to all EdA aircraft, not only those directly assigned. Seville's expertise is in pneumatic systems, while Albacete covers hydraulic equipment. Repair of one of these systems, regardless of aircraft type, will be the responsibility of Seville or Albacete.

MAESAL, which celebrated its 80th anniversary last year, is located between the area occupied by the EdA's Ala 14 (14th Wing) and installations belonging to the Tactical Leadership Programme (TLP). It covers almost half a million square metres, including command and administrative buildings, maintenance and specialised workshops, spare parts storage, a parking apron and access to active runways.

supporting the Spanish Air Force

Responsibility for heavy maintenance, repair and overhaul (MRO) of Spanish Air Force aircraft falls upon the specialised workshops known as Maestranzas Aéreas, three of which are currently active. ***Rafael Treviño Martínez*** *and* ***Salvador Mafé Huertas*** *investigate their work at Albacete.*

MAESAL's evolution

Established by a Royal Decree dated November 24, 1939, MAESAL was originally located only a few hundred metres away from its current site. Its subsequent historic development can be divided into four stages.

First, between 1939 and 1952, MAESAL carried out maintenance for the bulk of the EdA fleet – more than 30 different aircraft and 17 engine types, mainly older models dating back to the Spanish Civil War. Since many of the aircraft were no longer in production, availability of spares was almost nil and keeping them flying was a huge challenge.

The second period of evolution was between 1953 and 1968, when MAESAL specialised in the EdA's light aviation assets.

From 1969 to 1981, MAESAL transitioned to medium and heavy aircraft and began heavy maintenance for types including the CL-215T. This required an expansion of installations and the incorporation of new resources.

The fourth stage – started in early 1981 and lasting until 2008 – involved a significant ▶

Above: ***While the US Navy's Hornets are subject to 'on condition' maintenance, the EdA introduced a Level C inspection for its EF-18M/F/A-18A+ fleet, including F/A-18A+ C.15-79 '46-07', a former US Navy jet operated by Ala 46 at Gando.*** *All photos Salvador Mafé Huertas unless stated* ***Top:*** ***The EdA's trusty CL-215T/415 firefighting amphibians are the largest aircraft regularly serviced at MAESAL. Parked outside at Albacete are two CL-215Ts from Grupo 43: UD.13-27 '43-27' and UD.13T-23 '43-23'. These aircraft are scheduled to visit the facility every 1,800 flight hours.*** *Rafael Treviño Martínez*

modernisation process as MAESAL assumed responsibility for major inspections of the Mirage F1. This required a 60% expansion of hangar infrastructure and 20% increase in personnel, who had to follow an intensive plan to develop their technological know-how.

Today, MAESAL has some 410 men and women – of these, 210 are military personnel, including 40 commissioned ranks. If required, the staff can be augmented by another 60 contracted civilians. Some work is always outsourced; for example, aircraft are painted by a contracted company using MAESAL resources and paint cabins.

Engine inspection for a CL-215T, UD.13-17 '431-17', powered by a pair of Pratt & Whitney PW123 turboprops. On average, each CL-215T/415 will accumulate 400 flight hours during the busy summer season. *Rafael Treviño Martínez*

How maintenance is done

Generally speaking, the EdA organises aircraft maintenance into three levels or 'echelons.' The first level, Level A, is performed daily, including pre and post-flight inspections, simple repairs, configuration for the mission and installation/removal of weapons and equipment. Most of these tasks can be performed within two hours and work is performed at the aircraft's home base.

The second, Level B, encompasses programmed inspections required on the basis of flight hours accumulated or calendar time elapsed. It also covers more complex airframe repairs and inspections/repair of equipment including replacement of elements. The aircraft remains grounded for the duration of the inspections. This maintenance is normally accomplished at the home base; these are straightforward and repetitive inspections, such as the programmed 100-hours (H1), 200-hours (H2) and 400-hours (H3) increments for the Hornets. If any particular problem is detected, the Maestranzas send specialised personnel and equipment to solve it.

To support aircraft while away from home base, the technical assets required to perform Level A inspections have to be fully deployable while some of those required for Level B may also need to be mobile, depending on duration of the deployment.

Finally, the third echelon – Level C – is wholly the responsibility of the Maestranzas Aéreas. The aircraft is moved to the relevant facility for general inspection or overhaul, repair of important components, plus check-ups and deep repairs for particular equipment and subassemblies. These inspections are not always programmed; they may be the consequence of accidents or mishaps.

On entering the workshop, the first job is to remove the aircraft's engines for separate treatment – so-called inspect and repair as necessary (IRAN).

The next items to be removed are the wings, also for detailed inspection. Next to be detached are the undercarriage assemblies and finally all the remaining elements, including ejection seats, avionics and radar. The paint coat is then stripped off and the aircraft is down to its 'bare bones.'

On average, some 20% of the EdA combat fleet visits MAESAL each year. According to Colonel Fernando Javier Álvarez Sintes, commander of MAESAL, a Level C inspection for a Hornet or C-101 usually takes around 15 months before the jet is returned to its unit. He noted that this figure is not formally planned, but is routinely achieved.

The facilities

To perform its work, MAESAL has three dedicated hangars, one exclusively for the C-101 and able to accommodate eight or nine aircraft, another one for the F-5M, Hornet and Typhoon, and a third dedicated to the CL-215T/415 – large enough to hold a maximum of five of these aircraft.

The combat jet hangar can process ten aircraft simultaneously. At the time of *AFM's* visit to the unit there were two F-5Ms, one Typhoon and several EF-18M/F/A-18A+ jets in various states of repair, with multiple subassemblies

Above: ***Aviojets normally visit MAESAL after accumulating 1,800 flight hours – some of them are now on their third 1,800-hours inspection. Up on jacks is C-101EB E.25-84 '79-04' that has seen recent service with both the Academia General del Aire and with CLAEX.***

awaiting reinstallation, and aircraft surrounded by tools, ladders, scaffolding, hoses, cranes and personnel. Although it may appear chaotic, each aircraft has a dedicated team of technicians who know where everything is located.

Each hangar is commanded by a lieutenant or captain focusing on the engineering aspects and supported by a group of highly experienced non-commissioned officers or civilian technicians with many years of experience. Normally, the commanding officer holds a university degree in aerospace engineering and is part of the EdA's Cuerpo de Ingenieros Aeronáuticos (Aeronautical Engineers Corps).

C-101

The C-101 trainer is flown by the Academia General del Aire (AGA), the Patrulla Águila aerobatic team and 741 Escuadrón at Matacán air base in Salamanca. Four more examples are operated by the Centro Logístico de Armamento y Experimentación (CLAEX) for experimental purposes and are consequently fast approaching the end of their useful lives.

Normally, Aviojets visit MAESAL after accumulating 1,800 flight hours. Some aircraft are now undergoing their third 1,800-hour inspections, reflecting intensive usage.

During *AFM's* visit, one C-101 in Patrulla Águila colours was being written off since only 100 hours of useful life remained on the airframe and the repairs required to return it to flight status were not deemed economically viable. It was being readied for delivery to the EdA's Museo del Aire in Madrid. Useful elements were inspected and certified for use as spares for the other aircraft.

Not all written-off aircraft are scrapped, sold or sent to museums. Some go to the EdA's maintenance schools as instructional airframes for technicians. For example, four Mirage F1s have been sent to these institutions.

Since the C-101 was designed and built in Spain there's a high level of knowledge of its intricacies. The Aviojet is no longer in production, so the EdA is the engineering authority and MAESAL is the technical lead for the type. This allows numerous local modifications to be made. Colonel Álvarez mentioned the coloured smoke system installed in Patrulla Águila aircraft, which was entirely designed, built and installed locally. It involves a complex internal installation of gas-oil tanks and an ejector system. Such modifications are submitted to the Dirección General de Armamento y Material (DGAM) for approval.

F-5M

The remaining fleet of two-seat F-5Ms is used exclusively by Ala 23 for advanced training and the aircraft receive attention from MAESAL when required.

This year, the type celebrates its 50th anniversary in EdA service and intensive use has accumulated stress fatigue in certain structural parts. To ensure they remain a reliable asset, the entire fleet has undergone structural repairs and wing replacement. Work on the final example was completed in December 2018.

The EdA initially ordered 140 aircraft, later reduced to 70. The first were received in broken-down form and assembled in Spain, while later aircraft were entirely fabricated by manufacturer CASA; as a result, there's a good basis of local knowledge.

***Above:** The Typhoons serving with Ala 14 at Albacete and Ala 11 at Morón are still very young. With only between 1,000 and 1,500 flight hours for the fleet-leaders, few have reached the Level C inspection. Single-seater C.16-49 '14-13' is one of Ala 14's Tranche 2 jets. **Below:** On arrival at MAESAL's workshops, the first job is to remove the aircraft's engines, which are subject to inspect and repair as necessary (IRAN) maintenance. Operated by Ala 23, F-5M AE.9-11 '23-05' has its rear fuselage removed for an engine change.*

Construction of the aircraft introduced some new technologies to the country, including chemical milling for fabrication of the wings. Since 140 wing assemblies were produced for the intended order, the 70 surplus sets were kept in deep storage and have provided a useful reserve to extend the life of the surviving aircraft. Other structural parts can be furnished locally, if required.

When asked about the F-5M's remaining service life, Colonel Álvarez observed wryly: "Having seen what we've seen, I believe it is infinite," noting that the 1950s and 1960s were the golden age for American aircraft design.

However, due to its age, the F-5M is subject to a greater degree of radiographic airframe inspection to assure airworthiness, and detailed checks are required at MAESAL every 900 and 1,200 flight hours. While most of the Freedom Fighter airframe's parts are still original, the MRO procedure is now being rationalised, focusing inspections on the most critical components.

Hornet

Another frequent MAESAL customer is the EF-18M/F/A-18A+ that serves with Ala 12 in Torrejón, Ala 15 in Zaragoza, Ala 46 in Gando, plus some examples operated by CLAEX.

Initially, the Hornet didn't receive Level C inspections. Because of its naval origin, maintenance was completed 'on condition' and, according to US Navy procedure, the fighters would be struck off charge after reaching 6,000 flight hours. This timeline initially applied to the Spanish jets too. But these aircraft operate

***Above:** Most of the EdA's Aviojet trainers will be replaced by the Pilatus PC-21, but for the time being, the type remains in service with the Academia General del Aire and the Patrulla Águila aerobatic team at Murcia-San Javier, 741 Escuadrón at Matacán air base in Salamanca and with CLAEX. This is C-101EB E.25-23 '79-23', now moved to Cuatro Vientos for display at the Museo del Aire.*

Regular customers of MAESAL are the EF-18M/F/A-18A+ fighters serving with Ala 12 in Torrejón, Ala 15 in Zaragoza, Ala 46 in Gando, plus some examples operated by CLAEX. The local Programa de Modificación Mayor (PMM) is extending their service life to 9,000 hours.

solely from land bases, which reduces stress and corrosion to the airframes. Inspections at 6,000 hours revealed the airframe was in good shape and it was deemed cost-effective to extend service life. A locally designed upgrade programme boosted service life to 7,000 hours. After good results with this experience, a locally developed Programa de Modificación Mayor (PMM) is further increasing service life to 9,000 hours. In this way, the EdA has become totally autonomous in the maintenance and upgrade of its Hornets, covering both mechanical parts and software updates.

The aircraft that demand most attention are those serving with Ala 46 at Gando in the Canary Islands. These were purchased secondhand from the US Navy and already had some corrosion after years of serving from carriers. They have continued operating in a saline environment, causing further problems. These aircraft will therefore be the first to be retired and it's not unusual for MAESAL to send its technicians to Gando to support Level B inspections. When the budget allows, it's expected the Canaries-based jets will be replaced by 20 latest-standard Typhoons.

In December 2018, a technical commission from the US Navy visited the unit within the framework of the F/A-18 programme. MAESAL was recognised as an authorised maintenance centre for Hornet nose radomes, but this may expand to incorporate landing gears and control surfaces in future.

Typhoon

The Eurofighter fleet serving with Ala 14 at Albacete and Ala 11 at Morón is still very young. The fleet-leaders have accumulated around 1,000 to 1,500 flight hours and few jets have required a Level C inspection. A first full inspection was completed in 2014 on two-seat CE.16-09 '11-78' after an operational mishap that damaged the forward fuselage skin. It entered the MAESAL workshops on February 21, 2013 and once repaired, tested and the airworthiness certificate renewed, was returned to flight status on July 21 the following year. While grounded, in addition to the specific repairs, several technical directives were incorporated, including upgrade to Tranche 2 standard capabilities.

As regards the Typhoon, the immediate future of the unit focuses on four aspects:

- Continuous adaptation to accommodate new technologies
- Minimising risk across areas including quality assurance and environmental protection
- Establishing a competitive strategy, at national and international level, by extending NATO-required quality certifications to all production activities
- Ensuring personnel replacement to avoid loss of knowledge and abilities

As part of efforts to ensure sufficient skilled personnel, agreements have been signed with the defence ministry, universities and regional authorities, offering hands-on training for students and apprentices.

Meanwhile, MAESAL is working closely with Typhoon units to accumulate the know-how required for Level C inspection or future major revisions.

This is one of the two J85-GE-13 single-shaft turbojets from an F-5M. Licenced production of the Freedom Fighter ensured a good basis of local knowledge.

CL-215T/415

The EdA's CL-215T/415 fleet poses a particular problem for MAESAL. The aircraft are scheduled to visit MAESAL every 1,800 flight hours, but the high demand for these water-bombers during the summer forest firefighting campaign requires a special maintenance policy to ensure the maximum number of available aircraft. Work is normally conducted during the winter, to have the amphibians ready for the firefighting season, which runs from June to the end of September.

During these four months, around 400 aircraft are distributed across the country, including all available EdA CL-215T/415s, Unidad Militar de Emergencias (UME, Military Emergencies Unit) helicopters, plus light fixed-wing aircraft and civil helicopters equipped for firefighting. Each aircraft accumulates an average of 400 flight hours during the summer, depending on the area of deployment.

The heavy maintenance programme for the CL-215T/415s is divided into three blocks of 600 flight hours each, to limit the amount of time the aircraft are grounded.

The engines and propellers receive a deep inspection every 500 hours: when the aircraft enters the workshop for its 600-hours inspection, the 500-hours inspection for the engines and props is either made in advance or slightly later.

Frequent operation in saltwater to fill the tanks

***Above:** The high demand for the CL-215T/415 during the summer forest firefighting campaigns made it necessary to develop a special maintenance policy to have the maximum number of aircraft available.* Rafael Treviño Martínez
***Right & below:** The twin water tanks on board a CL-215T (below) are fed by the under-hull water scoops (right). In favourable conditions a CL-215T/415 travelling at 70kts can scoop up 6,000 litres of water in just 12 seconds, covering the equivalent of 1,350ft. The CL-215T has a two-door 'bomb bay' while the 415 has four doors.*

can present corrosion problems on the lower part of the aircraft. Preventive actions, such as washing with fresh water, are accomplished by the crews at deployment bases, and the fight against corrosion is continuous.

This fleet has four 'hangar queens' that are the oldest aircraft, manufactured more than 35 years ago. When entering MAESAL for inspection, these receive a special treatment on the undersides, but remain fully operational.

Other workshops

There are no fewer than 12 specialised workshops, among them those dedicated to ejection seats and radars, which focus on maintenance and major repairs of these systems, including an anechoic chamber to measure antenna radiation.

MAESAL is also upgrading the EF-18M fleet's 30 Litening II targeting pods, adding some improvements from the more advanced Litening III and incorporating ROVER (Remotely Operated Video Enhanced Receiver) capability – allowing real-time downlink of images gathered by the pod onto a ruggedised laptop computer used by a Joint Terminal Attack Controller (JTAC).

The propulsion shop has technologies to apply plasma projection to engines' combustion chambers as well as laboratories that can undertake robotised non-destructive inspection (NDI).

In addition to its hangars for aircraft maintenance, MAESAL has one of the EdA's largest spare-parts storage areas, with catalogue references for almost half a million parts. A dedicated logistics system keeps track of the supply, engineering and maintenance of various weapons systems. A part can be ordered from any workshop terminal, with the system indicating the nearest warehouse in which the part is available, its precise location, and how many examples are in the inventory.

The space dedicated to warehouses exceeds 882,867 cu ft (25,000m^3) and is being expanded. There are specific warehouses for items in useable condition, repairable materials, those due to be written off, parts in transit, office materials, aircraft tyres and others. A separate warehouse is dedicated to hazardous products such as paints, bonding agents, flammable materials and textiles.

Around 3,000 pieces of equipment are subject to intervention in the different MAESAL workshops, from the simplest small valve to sophisticated radars, ejection seats or undercarriage. As well as those removed from the aircraft under inspection at MAESAL, other parts come direct from the operational units.

One other unsung role is the transport to Albacete by road of aircraft that cannot fly. The unit sends a team of technicians who dismantle the aircraft on site, load it on a flat cargo platform and drive it to the facility by road. This can be accomplished for all MAESAL's aircraft types, with the exception of the big CL-215T/415. AFM

Russia's Western Military District

'West air power

Above: ***This 47 BAP Su-34 is outfitted with Khibiny-10V radar jamming pods on the wing tips. The regiment at Voronezh-Baltimor was the first frontline VKS unit to convert to the 'Fullback' and also the first one to receive the Khibiny-10V pods in 2014.*** *All photos Andrey Zinchuk unless stated*

The Zapadnyy Voyennyi Okrug (Western Military District, WMD) is the Russian military's most important territorial command in terms of area of responsibility, covering the country's two biggest urban centres – Moscow and St Petersburg. It also includes a significant proportion of Russia's industrial capacity, concentrated in the so-called Central Industrial Region. Last but not least, this is the military district with the longest frontiers with NATO member states, both in the continental part of the country and the Kaliningrad exclave; its area of responsibility also extends over the vast majority of the Baltic Sea. Additionally, the WMD has long frontiers with the northern and eastern regions of Ukraine, which is currently regarded as a non-friendly neighbour, aspiring to join NATO in the foreseeable future.

Alongside Sukhoputnyje voyska (SV, Russian Ground Troops) and Vozdushno-kosmicheskiye sily (VKS, Russian Aerospace Forces) units in the western regions of the country, the WMD also controls the Baltiyskiy Flot (BF, Baltic Fleet), which fields its own air service, offering a plethora of combat capabilities (see also *Knights Of Chkalovsk,* July 2017, p60-66). In wartime, the WMD would also exercise operational control over Rosgvardia (Russian Federal National Guard Service) and the border guard troops of the Federalnaya sluzhba bezopasnosti (FSB, Federal Security Service) stationed in its area of responsibility, as well as the paramilitary Ministerstvo cherezvychainykh situatsiy (MChS, Ministry of Emergency Situations).

Established in October 2010, the WMD boasts the most capable air defence coverage in Russia, with three principal zones saturated with ground-based air defence (GBAD)

end'

Russia's Western Military District is a territorial joint forces command on the front line of rising tensions with the Western world, and bordering with the NATO member states of Poland, Estonia, Latvia and Lithuania. ***Alexander Mladenov*** *assesses its strength.*

systems, capable of countering both aircraft and tactical ballistic missiles. The first of these covers a vast area around the capital Moscow and the Central Industrial Region, while the second is tasked with providing air defence for St Petersburg, and the third zone is in the remote Kaliningrad exclave.

The WMD also has a powerful air defence fighter force, including three squadrons equipped with Su-35S jets in addition to two more with Su-30SMs. Two more still operate 'legacy' Su-27P/UBs and two are outfitted with upgraded MiG-31BMs. The district's tactical strike force is much smaller, represented by two Su-34-equipped squadrons in addition to one naval attack squadron equipped with Su-30SMs and another with Su-24Ms. However, the dedicated tactical strike assets in the WMD structure could easily be reinforced if required by the five available fighter squadrons equipped with the Su-35S and Su-30SM – both these new-generation *Flanker* derivatives are endowed with meaningful multi-role capabilities and can deploy all the latest air-launched guided bombs and missiles in the Russian arsenal. The tactical reconnaissance branch is represented by one squadron only, operating a mixed fleet of Su-24MR fast jets and An-30 turboprops.

The battlefield assault, attack and anti-tank capabilities available in the WMD – grouped within the Army Aviation branch – are represented by no fewer than five dedicated attack helicopter squadrons flying heavily armoured gunships armed with anti-tank guided missiles, augmented by at least four assault transport squadrons equipped with armed helicopters, plus one composite squadron with a mixed fleet of attack and assault transport rotorcraft.

Russia's Western Military District

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Air force assets

The VKS unit in the WMD structure is the 6 Armiya Voyenno-vozdushnykh sil i Protivovozdushnoy oborony (6 A VVS PVO, 6th Air Force and Air Defence Army), headquartered in St Petersburg. Established on August 1, 2015, it is a strategic-level structure exercising control over the Frontal Aviation assets in addition to Army Aviation and GBAD units stationed in the WMD area of responsibility. The 6 A VVS PVO commanding officer is Lieutenant General Alexander Duplinsky, who took office in August 2015.

The aviation structures of the 6 A VVS PVO include one composite air division, the 105 SAD (incorporating all Frontal Aviation air defence and strike assets, grouped in four regiments), in addition to one direct-reporting independent composite transport regiment that provides VIP and general air transport and liaison, as well as search and rescue (SAR) coverage. The Army Aviation component in the WMD is represented by one brigade and two regiments with a total strength of ten component squadrons available for battlefield operations.

One year after its establishment, in December 2016, the 6 A VVS PVO lost a proportion of its Frontal Aviation assets, which were handed over to the newly established Joint Strategic Command North placed under Russian Navy control. This brand new, strategic-level military structure is responsible for the control of all armed forces branches stationed in the northwestern corner of Russia and the adjacent deep-frozen parts of the Arctic under Russian control. Frontal Aviation assets previously belonging to the 6 A VVS PVO that were inherited by the new command structure included the 98 SAP, stationed at Monchegorsk on the Kola Peninsula. This is a composite aviation regiment which, at the time, comprised three fast-jet squadrons – a frontal bomber squadron flying Su-24M *Fencer-Ds*, a reconnaissance squadron equipped with Su-24MR *Fencer-Es* and a third squadron flying upgraded MiG-31BM long-range fighter-interceptors. Currently, the 98 SAP is controlled by the 45 A VVS PVO, which fields all the air and air defence assets of the Strategic Command North.

In the latest training year (between December 1, 2018 and November 30, 2019) the 6 A VVS PVO flew in excess of 34,000 hours, including more than 1,000 combat employment practice sorties using live munitions. According to information released by the Russian defence ministry,

WMD order of battle: VKS units

Unit	Base	Types
6th Air Force and Air Defence Army	**St Petersburg**	
Direct-reporting units		
33 OTSAP Two composite transport squadrons	St Petersburg-Levashovo and Vladimir-Semyazino	An-26, An-12, An-72, Tu-134, An-148-100E, L-410UVP-E20, Mi-8MT/MTV-2/5, Mi-26
4 ORAE One independent reconnaissance squadron	Shatalovo	Su-24MR, An-30
105 SAD	Voronezh	
14 IAP Two fighter squadrons	Kursk-Khalino	Su-30SM
159 IAP Two fighter squadrons	Besovets	Su-35S
790 IAP Three fighter squadrons	Khotilovo	Su-35S, MiG-31BM
47 BAP Two frontal bomber squadrons	Voronezh-Baltimor*	Su-34
Army Aviation		
15 Br AA Two attack and two assault transport squadrons and a detachment of heavy transport helicopters	Ostrov	Ka-52, Mi-28N/UB, Mi-26, Mi-8MTV-5-1
440 OVP Two attack and one assault transport squadron, and an EW detachment	Vyazma	Ka-52, Mi-24P, Mi-8MTV-5-1, Mi-8MTPR-1
549 OVP One attack, one assault transport and one composite squadron (equipped with a mixture of attack and assault transport helicopters)	Pushkin and Pribylovo	Mi-35M, Mi-28N/UB, Mi-24P, Mi-8MTV-2/MTV-5-1

Note: **Aircraft temporarily based at Buturlinovka. Status as of January 2020. This information has been compiled using publicly available information. No official data has been released since the substantial reforms undertaken in 2014.*

combat employment practice in the WMD in 2019 saw the expenditure of no fewer than 8,500 munitions, a figure that includes 2,900 bombs, 3,000 unguided rockets and 2,600 gun rounds of 23mm and 30mm calibre, plus a small number of guided air-to-air and air-to-surface missiles.

Tactical recapitalisation

The WMD's tactical air power, included in the 6 A VVS PVO, embarked on a rapid recapitalisation drive back in 2013, when the two component squadrons of what was then known as the 1st Aviation Group of the 7000th Aviation Base stationed at Voronezh-Baltimor completed transition to the Su-34 *Fullback*. The group eventually received a total of 24 *Fullback* new-generation frontal bombers to replace its entire Su-24M *Fencer-D* fleet.

The Su-34-equipped unit was then reorganised as the 47 BAP in December 2014 – a two-squadron bomber regiment – and, by mid-2015, it was declared fully combat-capable with the new type. The 47 BAP was among the first VKS units called upon to deploy on short notice to Khmeimim/Latakia air base in Syria in September 2015, providing an initial detachment of four aircraft. The *Fullbacks* began flying combat missions from day one of Russia's campaign in Syria, with ▶

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***1:** The Mi-24P remains in service with two squadrons in the WMD. One of these, assigned to the 549 OVP and stationed at Pribylovo, has a mixed fleet of Mi-24Ps and Mi-8MTV-1/5s, while the second is a dedicated attack squadron of the 440 OVP at Vyazma, fully equipped with Mi-24Ps, as seen here. **2:** The Su-35S force within the WMD comprises 36 aircraft with a primary air defence tasking. Here, Su-35S '23 Red'/RF-81763 from the 159 IAP taxies past a line-up of 14 IAP Su-30SMs. **3:** The Su-30SM is the Russian Naval Aviation service's new multi-role type, with one squadron assigned to the 4 MShAP at Chkalovsk. It is equipped with 12 aircraft, taken on strength between 2016 and 2018. Alexander Mladenov **4:** The WMD's force of 24 Su-30SM multi-role heavyweight fighters serves with the two squadrons of the 14 IAP at Kursk-Khalino, situated not far from the Ukrainian border.*

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Transport component

The WMD's air transport capability is provided by the 33 OTSAP, an independent composite aviation regiment stationed at Levashovo airfield near St Petersburg, reporting directly to the 6 A VVS PVO headquarters. It has a wide variety of fixed-wing transports, dominated by the obsolescent An-26 and An-12BK turboprops used for general cargo and troop transport, with six and three examples in service, respectively. The VIP and personnel transport fleet is represented by the newer An-148-100E, two of which were taken on strength in 2014 and 2017, augmented by a single Tu-134AK. Four more L-410UVP-E20s and six An-72s are used for passenger transport and liaison, and there's a single An-30 photo survey aircraft. The regiment's helicopter fleet includes no fewer than 16 Mi-8MT/MTV-2s in addition to a single Mi-26 heavy-lift helicopter taken on strength in 2018. Some of the An-72s and Mi-8MTV-2s are used for supporting operations at the nuclear test range on Novaya Zemlya island, controlled by the Russian defence ministry's 12th Main Directorate.

The 33 OTSAP also has a component composite transport squadron stationed at Vladimir-Semyazino airfield east of Moscow, which operates a fleet of six An-26s and seven Mi-8MTV-5s.

***Above:** This An-26 transport is assigned to the 33 OTSAP, an independent transport composite regiment, home-based in Levashovo near St Petersburg.*
***Below:** An An-12 from the fleet of the 33 OTSAP, used for general cargo and personnel transportation within the WMD area of responsibility.*

extensive delivery of precision air-to-surface munitions, including laser and TV-guided bombs and missiles in addition to the newly fielded satellite-guided bombs.

The re-equipment of five component squadrons grouped in three fighter regiments, controlled by the 105 SAD, proved to be a protracted affair. Provision of new aircraft began in 2009 with the introduction of ex-Algerian Air Force MiG-29SMT/UBT fighters with an expanded multi-role capability. In 2015, the fighter fleet recapitalisation process continued with the introduction of the first Su-35S multi-role fighters with the 159 IAP, a fighter regiment stationed at Besovets, where the new type was intended to replace both 'legacy' Su-27Ps and upgraded Su-27SMs. Transition to the new type by the two component squadrons of the Besovets regiment was reportedly completed in 2018. The 159 IAP received a total of 24 aircraft plus six more intended for temporary use and subsequently handed over to the third squadron in the WMD to receive the new type.

The Su-35S was next fielded by the 790 IAP stationed at Khotilovo, which had operated a diverse fleet of Su-27P/SM/UBs within one component squadron until December 2018. The unit took an initial batch of three Su-35S jets on strength in January 2019 and by October that year had received three more, together with a batch of six originally delivered in 2018 to the 159 IAP for temporary use, reaching its authorised squadron strength of 12 jets.

The 790 IAP was also equipped with two squadrons of upgraded

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MiG-31BM/BSM fighters, with a total fleet of 24 aircraft. The regiment took the upgraded *Foxhound* on strength between 2014 and 2016, replacing non-upgraded MiG-31 derivatives.

The Su-30SM is another new-generation, multi-role fighter type involved in the re-equipment of the WMD tactical aviation force. The jet was introduced with the 14 IAP stationed at Kursk-Khalino airfield in June 2017, replacing the MiG-29SMT/UBTs operated by its two component squadrons – a total of around 30 aircraft. The unit's transition to the new, much heavier and more capable multi-role fighter was reportedly completed in December 2018, with 24 brand new Su-30SMs taken on strength.

The WMD fields a sole reconnaissance squadron, the 4 ORAE, established in mid-2015 at Shatalovo airfield near Smolensk. It is equipped with six to eight Su-24MRs in addition to two to four An-30 twin-engine turboprops outfitted for photo survey.

In 2016, the then VKS commander-in-chief, Colonel General Viktor Bondarev, announced that the WMD was set to receive its own Su-25-equipped attack regiment. This was to be the reactivated 899 ShAP at Buturlinovka (disbanded in 2009), apparently scheduled at the time to be brought online in December 2017. The regiment was to comprise two component squadrons equipped with Su-25 armoured attack aircraft. But now it seems that re-establishment has been shelved or at least considerably delayed – apparently due to a lack of available airworthy *Frogfoots*. Recommissioning will take place by December at the earliest.

Likewise, the Russian defence ministry plans – as revealed by Russian daily newspaper *Izvestia* in August 2018 – foreseeing the formation of an additional Su-24M-equipped squadron within the WMD, to be stationed at Shatalovo, have been shelved or at least seriously delayed.

Army Aviation renewal and expansion

The WMD's Army Aviation branch – directly reporting to the 6 A VVS PVO headquarters in St Petersburg – has expanded significantly in recent years. While in late 2013 its strength comprised only four or five frontline squadrons, two years later this figure had increased to eight. Today the Army Aviation force stationed in the WMD is represented by two independent helicopter regiments – the 549 and 440 OVPs – in addition to one army aviation brigade – the 15 Brigada Armeyskoi (15 Br AA, 15th Army Aviation Brigade). These field a total of ten frontline squadrons with a combined fleet of between 180 and 200 rotorcraft.

The Mi-8MTV-5-1 is backbone of the assault transport fleet, operated by four squadrons with a total of around 80 examples. The two independent helicopter regiments each operate a single Mi-8MTV-5-1-equipped squadron, while the Ostrov-based brigade fields two. In addition, there are a dozen or so of the older-generation Mi-8MTV-2s within the 549 OVP's composite squadron, stationed at Pribylovo. The 440 OVP at Vyazma also has a dedicated flight or detachment within its structure equipped

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***1:** The Su-24M 'Fencer-D' frontal bomber equips a single squadron of the Baltic Fleet air arm, together with a handful of Su-24MR 'Fencer-Es' used for reconnaissance. The ageing Su-24 is set for replacement in the 4 MShAP fleet by the multi-role Su-30SM. **2:** The 15 Br AA at Ostrov operates a pair of squadrons equipped with Mi-8MTV-5-1 assault transport helicopters. **3:** The Su-27P serves with the two-squadron 689 IAP, re-established at Chkalovsk in December 2018. Considered the busiest Russian fighter unit and involved in round-the-clock QRA duty over the Baltic Sea, its non-upgraded 'Flankers' frequently encounter NATO reconnaissance aircraft over neutral waters. This is an aircraft previously flown by the 790 IAP, apparently transferred to the 689 IAP.* Finnish Air Force

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with Mi-8MTPR-1 electronic warfare (EW) helicopters.

The Mi-28N/UB attack helicopter is operated by a single squadron of the 549 OVP at Pushkin near St Petersburg. Mi-28N deliveries were undertaken between 2014 and 2016, while the enhanced Mi-28UB derivative – outfitted with dual controls and mast-mounted radar – was taken on strength between 2017 and 2019. The other Mi-28N/UB operator in the WMD is one of the two component attack squadrons of the 15 Br AA at Ostrov, which accepted its first machines in December 2013. In addition to their main fleets of Mi-28N/UBs (up to 16 in each squadron), each of these also fields six Mi-35M gunships. The composite squadron of the 549 OVP operates about 12 of the older Mi-24Ps; in addition, the 'legacy' Mi-24P remains in service with one of the two component attack squadrons of the 440 OVP, with no fewer than 16 examples.

The Ka-52 is the second new-generation attack helicopter type, first fielded within the WMD by the then newly established 15 Br AA at Ostrov. Its Ka-52-equipped attack squadron received its first helicopters in early 2014; currently the fleet comprises 14 aircraft. The second squadron in the WMD equipped with Ka-52s is assigned to the 440 OVP at Vyazma. It received its first machines in June 2017 and currently numbers 12 aircraft.

Baltic Fleet aviation

The Baltic Fleet's aviation service is represented by the 132 SAD with its headquarters in the heavily militarised Kaliningrad exclave, a region without land connections to mainland Russia. This is a composite aviation division, apparently established early last year, controlling one fighter, one naval attack and one composite helicopter regiment, plus a single transport squadron. In 2019, the Baltic Fleet units logged in excess of 5,000 flight hours and flew more than 2,300 combat employment training sorties.

The 132 SAD's land-based fast jet fleet is grouped in four squadrons assigned to two regiments, stationed since October 2018 at the newly refurbished Chkalovsk airfield, Kaliningrad. The 4 MShAP, re-established in December 2017, is a naval attack aviation regiment which fields one squadron equipped with a dozen Su-30SM multi-role fighters, while its second squadron operates a mixture of Su-24M frontal bombers and Su-24MR reconnaissance aircraft; reportedly, around 14 *Fencers* were in active service in 2018. The introduction of the multi-role Su-30SM took place between 2016 and 2018, and the two-seat advanced *Flanker* derivative has a primary strike role with Russian Naval Aviation, while also retaining significant air-to-air potential.

The air defence fighter assets

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***1:** The upgraded 'Foxhounds' from the Khotilovo-based 790 IAP are mainly tasked with providing air defence to the Russian capital Moscow and the adjacent Central Industrial Region. **2:** This Ka-27PS shipborne SAR helicopter is operated by the Baltic Fleet's composite helicopter regiment stationed at Donskoye airfield near Kaliningrad. **3:** The 790 IAP is the latest frontline VKS unit to take on strength the Su-35S. **4:** These Mi-28Ns belong to the attack squadron of the 549 OVP stationed at Pushkin airfield near St Petersburg. The WMD has two attack squadrons equipped with the new-generation helicopter, in addition to two more flying the Ka-52.* Russian MoD

WMD order of battle: Rosgvardia units

Unit	Base	Types
675 OSAP Two composite squadrons: one equipped with fixed-wing aircraft and the other with assault transport helicopters	Nizhny Novgorod-Strigino	Il-76MD, Mi-8MTV-2
70 OSAP ON Two composite squadrons: one equipped with fixed-wing aircraft and the other with assault transport helicopters	Kaluga-Yermolino	Il-76MD, An-12, An-26, Mi-8MTV-2, Mi-8T
7 OAE One independent aviation squadron equipped with assault transport helicopters	Pushkin	Mi-8MTV-2
11 OAE One independent aviation squadron equipped with assault transport helicopters	Voronezh	Mi-8MTV-2, Mi-8T
3 OSAE One independent composite aviation squadron equipped with a mixture of fixed-wing aircraft for passenger transport and assault transport helicopters	Stchelkovo	Mi-8MTV-2, An-72, Tu-134, Tu-154

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of the Baltic Fleet are represented by the two-squadron 689 IAP, a fighter aviation regiment equipped with 'legacy' Su-27s. The regiment was re-established on December 1, 2018, inheriting aircraft and aircrews from the fighter squadron of the now-disbanded 72nd Guards Aviation Base, at the time operating a fleet of around 13 Su-27P/UBs. Last year, the regiment's fleet is believed to have been strengthened by adding ex-VKS Su-27s, sourced from the WMD regiments converting to the Su-35S.

The *Flanker-B/C*-equipped regiment is among Russia's busiest military aviation units; still a relatively small formation, its aircrews are heavily burdened with their quick reaction alert (QRA) responsibility, which they maintain on a 24/7 basis under Russia's integrated air defence system. Covering the Kaliningrad exclave and the adjacent airspace over the Baltic Sea, they frequently scramble to intercept NATO reconnaissance aircraft flying over the Baltic and attempting to gather electronic and signals intelligence on Russian military installations and ships in the Kaliningrad area.

According to Colonel Vadim Morozov, the 132 SAD commander, speaking to the Russian defence ministry's official newspaper, *Krasnaya Zvezda* (Red Star), QRA Su-27s from the 689 IAP were scrambled on 35 missions to escort NATO reconnaissance aircraft between January and mid-July 2019. The NATO assets were both manned and unmanned, flying in airspace over the Baltic Sea, in close proximity to the Kaliningrad district. Russian military officials have repeatedly claimed that increased NATO activity in the Baltic Sea over recent years has generated a sharp increase in workload for the Baltic Fleet's fast jet units, causing multiple close encounters between Russian Navy fighters and Western aircraft and ships.

In addition to the all-important QRA duty, the Chkalovsk *Flankers* are also used on a regular basis to escort VKS aircraft, including frontal and strategic bombers performing long-range patrol flights over the Baltic, operating from bases in mainland Russia. Furthermore, they escort VKS aircraft with VIPs on board, flying between mainland Russia and the Kaliningrad District.

The composite helicopter regiment stationed at Donskoye was apparently established in mid-2018, but its numberplate has not been revealed; it comprises three component squadrons. The first of these has a fleet of shipborne helicopters, dominated by the upgraded Ka-27M used for anti-submarine warfare (ASW) and maritime surveillance. The first batch of five Ka-27Ms was taken on strength in October 2018 and

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The Mi-26 fleet, which used to serve the needs of the entire WMD, mainly for heavy-lift transport on the battlefield, is assigned to the 15 Br AA at Ostrov. *Russian MoD*

additional examples are reported to have followed late last year. This squadron also has a four-ship flight equipped with Ka-27PS helicopters for SAR and assault transport duties, plus a detachment of Ka-29 dedicated attack/assault transport helicopters, with at least three in active service. The second squadron is equipped with Mi-8MTV land-based helicopters for general and assault transport duties, while the third has Mi-24P/VP gunships for battlefield fire support.

The transport assets are grouped in the 398 OTAE, an independent transport squadron at Chkalovsk, equipped with five An-26s and a single Tu-134A-3 for VIP transport. In addition to their primary passenger and cargo transport tasking, the squadron's An-26s are also used for maritime SAR and parachute training of the naval infantry stationed in the Kaliningrad exclave. Since 2015, the Baltic Fleet An-26s have also assumed an offensive role, training to drop freefall bombs on targets lacking air defence coverage.

The Baltic Fleet unmanned aerial vehicle (UAV) squadron, also stationed at Chkalovsk, is equipped with one Forpost system in addition to one or two Orlan-10 systems. Among the primary tasks of the naval aviation's UAV force are artillery fire correction for warships, and coastal surveillance, as well as checking the condition of coastal military infrastructure and the effectiveness of camouflaging measures of naval infantry and other military units stationed in the Kaliningrad area. The Orlan-10 system is also deployable aboard the Baltic Fleet's Project 22800 missile corvettes to provide maritime and coastal surveillance and targeting support for the ship's own weapons systems.

Rosgvardia air units

The Rosgvardia is a relatively new internal security force in Russia, established in April 2016. It inherited all the military units of the Vnutrenniye Voiska (Internal Troops, IT), which had been subordinated to the Russian Ministry of Interior. The new formation is, in fact, a gendarmerie-style militarised service under direct control of Russia's President, Vladimir Putin, and numbering around 170,000 personnel. Its primary missions include law enforcement, counter-terrorism, territorial defence of Russia, security for important industrial and urban sites across the country, protection of truck and rail convoys with important cargoes and assisting border protection forces.

The Rosgvardia has a sizeable aviation branch mainly used for the transport of troops and materiel, armed escort, patrol over important transport infrastructure (such as highways, railways, pipelines and rivers), disaster relief, firefighting, searching for escaped prisoners and support of small and large-scale counter-insurgency (COIN) operations.

Most of the Rosgvardia fixed-wing aircraft wear smart colour schemes, while the helicopters are camouflaged, but easily distinguished from their VKS counterparts by a vertical white stripe applied on the tail boom.

A significant proportion of the service's 'quasi-military' aviation assets is found in the WMD, including two independent squadrons equipped with helicopters, stationed at Pushkin and Voronezh, plus one composite squadron at Stchelkovo and two independent composite aviation regiments at Nizhny Novgorod and Yermolino.

The regiments are among the largest aviation units within the Rosgvardia structure, endowed with long-range troop and cargo transport capability. The first of them, the 675 OSAP at Nizhny Novgorod, has a fleet of four Il-76MD heavy transport aircraft to provide mobility for ground units during large-scale COIN and law enforcement operations across Russia. The regiment also fields a helicopter squadron, equipped with armed Mi-8MTV-2s. The 70 OSAP ON in Yermolino, near Kaluga, is a direct-reporting regiment of the Rosgvardia Main Staff, equipped with four Il-76MDs, plus An-12s and An-26s, in addition to a squadron flying Mi-8MT/MTV-2 helicopters for assault and transport duties; the *Hips* can provide fire support with 80mm (3.15in) calibre rockets. The helicopter squadron also operates a few older-generation unarmed Mi-8Ts used for personnel and cargo transport duties.

The independent Rosgvardia squadrons stationed at Voronezh and Pushkin are equipped with armed Mi-8MTV-2 helicopters and the former also has a few Mi-8Ts in its fleet. The single composite aviation squadron stationed at Stchelkovo, near Moscow, is a direct-reporting unit of the Rosgvardia Main Staff, used for passenger and VIP transport with fixed-wing aircraft and helicopters. AFM

This Rosgvardia Mi-8MTV-2, armed with 80mm calibre rocket pods, belongs to the helicopter squadron of the 675 OSAP.

Abbreviations

BAP	Bombardirovochnyi aviatsionnyi polk	Bomber Aviation Regiment
IAP	Istrebitelnyi aviatsionnyi polk	Fighter Aviation Regiment
MShAP	Morskoy shturmovoy aviatsionnyi polk	Naval Attack Aviation Regiment
OAE	Otdelnaya aviatsionnaya eskadrilya	Independent Aviation Squadron
ORAE	Otdelnyi razvedyvatelnyi aviatsionnyi eskadrilya	Independent Reconnaissance Aviation Squadron
OSAE	Otdelnaya smeshannaya aviatsionnaya eskadrilya	Independent Composite Aviation Squadron
OSAP	Otdelnyi smeshannyi aviatsionnyi polk	Independent Composite Aviation Regiment
OSAP ON	Otdelnyi smeshannyi aviatsionnyi polk osobovo naznachenya	Independent Special-Purpose Composite Aviation Regiment
OTAE	Otdelnaya transportnaya aviatsionnaya eskadrilya	Independent Transport Aviation Squadron
OTSAP	Otdelnyi transportnyi smeshannyi aviatsionnyi polk	Independent Composite Transport Aviation Regiment
OVP	Otdelnyi vertoliotnyi polk	Independent Helicopter Aviation Regiment
SAD	Smeshannaya aviatsionnaya diviziya	Composite Aviation Division
SAP	Smeshannyi aviatsionnyi polk	Composite Aviation Regiment
ShAP	Shturmovoy aviatsionnyi polk	Attack Aviation Regiment

Russia's Western Military District air bases

The air power of the Western Military District is concentrated within the Vozdushno-kosmicheskiye sily (VKS, Russian Aerospace Forces), but it also controls the Baltiyskiy Flot (BF, Baltic Fleet), with bases in the Kaliningrad exclave. In wartime, the WMD would also have operational control of Rosgvardia (Russian Federal National Guard Service), which operates air units both at its own bases and others that are shared with the VKS.

VKS air bases

1. St Petersburg-Levashovo
2. Vladimir-Semyazino
3. Shatalovo
4. Kursk-Khalino
5. Besovets
6. Khotilovo
7. Voronezh-Baltimor
8. Ostrov
9. Vyazma
10. Pushkin
11. Pribylovo

Rosgvardia air bases

12. Nizhny Novgorod-Strigino
13. Kaluga-Yermolino
10. Pushkin
7. Voronezh-Baltimor
16. Stchelkovo

Baltic Fleet air bases

17. Chkalovsk
18. Donskoye
19. Chernyakhovsk

Swiss Air Force Cougar helicopters meet Swedish Air Force Gripens during an electronic warfare training exercise at the Vidsel Test Range. As Europe's largest land range, Vidsel is well suited for EW trials and training. It has few restrictions in the radio spectrum and EW systems can be positioned both within the range and outside its boundaries. *All photos FMV unless stated*

Pushing the limits Swedish style

The Swedish Defence Materiel Administration ensures the country's armed forces have the equipment they need to execute their mission. ***Thomas Newdick*** *investigates how its Flight Test Centre handles trials of airborne systems and makes use of the unique range at Vidsel, within the Arctic Circle.*

Sweden has a long heritage of self-sufficiency across many industrial areas and this has been enshrined in successive political decisions – within military aerospace, Saab remains perhaps the country's best-known example of this decision to 'go it alone.' However, this tradition extends across Swedish defence, encompassing the design, development, test and manufacture of its own fighters, as well as other military materiel.

The Swedish Defence Materiel Administration (FMV, Försvarets materielverk) is a governmental agency acting under the country's ministry of defence. Its role is to define requirements, procure and evaluate military equipment for the Swedish Armed Forces, which incorporates the army, navy, air force and home guard. The first three elements all share pooled capabilities such as training, logistics, command and intelligence. Within FMV, the Test & Evaluation (T&E) division is responsible for verification and validation of all equipment procured for the Swedish Armed Forces.

Within FMV T&E, the Flight Test Centre, or FTC, located in Linköping, in the south of the country, is responsible for test and evaluation in the air domain, its main task being to verify and validate aerial systems on behalf of the Swedish Armed Forces.

Currently, the largest project the FTC is involved is the Gripen fighter. As well as the efforts to bring the latest Gripen E into frontline service, the organisation is also busy working to sustain and upgrade the existing Gripen C/D fleet. Significant integration trials involving the Gripen C/D have involved clearing it to use the infrared-guided IRIS-T air-to-air missile, as well as the MBDA Meteor beyond-visual-range air-to-air missile (BVRAAM) – resulting in Sweden becoming the first user to declare this game-changing ramjet-powered weapon operational, in 2016.

All Gripen-related ground and flight tests that don't require the large restricted land and airspace available at the FMV's expansive Vidsel range are performed in Linköping.

While the indigenous fighter is the most prominent weapon system within the FTC's remit, the organisation is also involved in the design, upgrade and modification of all other fixed- and rotary-wing aircraft operated by the Swedish Armed Forces, ranging from the S 100D Argus airborne early warning and control (AEW&C) aircraft to the HKP 15 (Leonardo AW109).

The FTC has been located in Linköping for more than 80 years and became part of the FMV in 1974. However, the organisation also performs flight test duties at several other locations, including Karlsborg, Härnösand and Älvdalen. The 'jewel in the crown', however, is the unique Vidsel Test Range. There are around 130 people employed at FTC's Linköping branch and another 90 or so at Vidsel. These are all part of an FMV workforce that numbers around 1,700 people. Within this number are approximately ten test pilots for all disciplines.

Acceptance testing and UORs

The FMV is responsible for acceptance testing on behalf of the Swedish Armed Forces, comprising a verification method to demonstrate compliance with certification or contractual requirements. The original Gripen programme represents an example of this work in which all tests were carried out in Sweden. In this example, Saab performed the technical verification of the requirement, while the FMV was responsible for the functional verification and validation. Finally, the operational verification was done by the air force. In the current Gripen E programme this procedure has been refined and all three steps are being completed in a combined effort.

Urgent Operational Requirements (UORs) involve a rapid acceptance testing effort, an example being the Gripen's reconnaissance system after the Swedish government decided at short notice to participate in the multinational operation over Libya in 2011.

FMV T&E, Flight Test Centre and the Vidsel Test Range

Top: A precision-guided bomb moments before striking static targets during weapons testing at Vidsel. Bridges, roads or bunkers can be set up as targets according to customer requirements. Above: The bomb strikes the target. To make things harder, Vidsel is equipped to provide both GPS denial (jamming) and GPS deception (repeater), which can interfere with GPS-guided bombs. Right above: A German Army Tiger attack helicopter flying over Vidsel. As well as its comprehensive EW set-up, the range provides the possibility for low-level flying, use of countermeasures including chaff and flares, plus live firing. Right: An aerial view of the air base at the Vidsel Test Range.

Test personnel

The FMV's test pilots are typically experienced fighter aviators drawn from the Flygvapnet (Swedish Air Force). Depending on requirements the pilot might go directly to the FMV or, if needed, they will first enrol in one of the renowned test pilot schools – such as the US Naval Test Pilot School at Patuxent River, Maryland, the National Test Pilot School in Mojave, California, the École du Personnel Navigant d'Essais et de Réception (EPNER) at Istres in France, or the Empire Test Pilots' School (ETPS) at Boscombe Down in the UK. The individual retains their officer rank, but while working as a test pilot is employed by the FMV. After their period flying with the FMV, they return to the armed forces.

Alongside the test pilots, the FMV has roughly 35 flight test engineers covering all aspects of experimental work. They come from varied backgrounds, some arriving direct from upper secondary school and others already having achieved a master's degree in the field of science. Unlike their pilot counterparts, most of the engineers have a civil background. However, some of them will also have spent time abroad at test pilot schools, either for the full flight-test engineer course or for short courses, depending on FMV requirements.

As well as the T&E activities performed on behalf of the Swedish Armed Forces, the FTC in Linköping supports other Swedish authorities that require verification and validation of their airborne systems. Besides that, the centre works with companies and agencies from other countries – including defence industry and armed forces – writing verification and validation plans and even leading complete test programmes, including flight trials at Vidsel or other test facilities within Sweden.

The FMV's T&E division has the capability to perform electromagnetic pulse (EMP) testing on complete aircraft (or other vehicles) as well as on systems, sub-systems and individual components. Its EMP simulator is used for

Swedish fighter programmes and other international military projects and the related experiments are performed in an outdoor simulator at the Flight Test Centre's facilities in Linköping. Their purpose is normally to verify that the test objects fulfil the standards MIL-STD-461 requirements – the US military standard for electromagnetic compatibility.

Arctic Gripen

With the flight test campaign for Saab's new Gripen E fighter well under way, earlier this year the manufacturer took one of its jets to northern Sweden to see how it handled the harsh weather conditions. Its destination was Vidsel, home to a test range that covers 1,158sq miles (3,000km²) of restricted land area, including varied terrain, and 3,089sq miles (8,000km²) of restricted airspace extended from the ground to an unlimited altitude. Once installed, the Saab team evaluated how the Gripen E operates in the Nordic climate, assessing the impact on maintenance, normal start-ups, typical flight profiles, landings and braking on landing strips covered with natural snow and ice.

Vidsel is, by far, the largest overland test range in Europe. While many of the equivalent ranges in the US are bigger, Vidsel measures up in other respects, for example, when it comes to the jamming power that can be brought to bear on equipment that's being pushed to its limits. There's also no limitation on low-level flying or on supersonic flight.

In fact, when the multinational Arctic Challenge Exercise (ACE) is taking place at Vidsel, an even larger area of airspace is closed off – measuring up to 57,915sq miles (150,000km²) – making it considerably larger than that available for Red Flag at Nellis Air Force Base, Nevada and a little smaller than Red Flag Alaska. Participants in ACE have free rein not only over the Vidsel Test Range, but also elsewhere in Sweden and into the airspace over neighbouring Norway and Finland.

ACE manoeuvres involve several different air bases and ground facilities and Vidsel is available as an alternative landing area. The range there is also used for live weapons deliveries as part of the exercise and ground units are sometimes located within its boundaries, for additional training benefit and realism.

Home on the range

While the challenges of weather and geography are a feature of flying operations in northern Sweden, the Vidsel Test Range is open throughout the year. Depending on the type of

TP 86 Sabreliner

As an approved organisation with design authority for most of the fixed- and rotary-wing aircraft used by the Swedish Armed Forces, the Flight Test Centre in Linköping includes several aircraft types.

Among them is the unique TP 86 Sabreliner, 86-001. Having its own testbeds allows the FMV to easily make changes or install equipment necessary for a specific test and to maintain full control of the entire process. The Sabreliner has been involved in a number of programmes and has served as an airborne platform equipped with a generic jammer for evaluation of radar functions and as a testbed for experimental work.

The FMV's sole TP 86 Sabreliner, 86-001, taxies at RAF Brize Norton in Oxfordshire last December 19, after arriving from Billund, Denmark and before heading home to Linköping. *Westleigh Bushell*

***Above:** The spectacular results of infrared countermeasure trials from a Swedish Air Force JAS 39C Gripen. The FMV Flight Test Centre is responsible for developmental test and evaluation as well as acceptance testing for all airborne systems delivered to the Swedish Air Force.*

test, weather can be important. For example, when using laser-guided weapons or when firing live missiles, the requirement for clear weather becomes more significant. During the darkest period of the year – December to January – the hours of daylight are brief, reducing the time available for high-speed photo/video capture, but, on the other hand, these conditions are ideal for cold-weather testing and flights using night-vision goggles (NVGs).

Speaking after the recent Gripen E cold-weather trials at Vidsel, Katarina Milososka, a test aircraft co-ordinator at Saab, said: "The weather conditions were on our side and we were able to perform several normal start-ups and flights in temperatures spanning from -20 to -26 degrees Celsius. The result was above expectations and we got a lot of really valuable data to review."

As well as addressing meteorological factors, the FMV maintains a close co-operation with the indigenous Sámi people inhabiting part of northern Sweden. These are able to herd their reindeer on to parts of the range and their activities are taken into account during planning of the trials. However, it doesn't usually result in any restrictions placed on Vidsel's customers.

Environmental aspects are considered too, and specific target areas are used when deploying live bombs. As far as is practically possible, the FMV is required to collect all items of scrap resulting from bombings and firings.

A wide range of weapons can be used on the Vidsel Test Range, with the primary requirement being that all weapon scenarios fulfil the FMV's safety requirements in which risk of injury is below 10^{-6}. Among the air-to-air missiles that have been fired over the range are the AIM-120 Advanced Medium-Range Air-to-Air Missile (AMRAAM), Meteor BVRAAM and IRIS-T – all of which are in Flygvapnet service. Cruise missiles flown here include the Swedish-German Taurus and the MBDA Storm Shadow. Large guided bombs like the GBU-54 and GBU-48 have also been dropped. Furthermore, Vidsel has hosted test firings for ground-based air defence systems such as the HAWK, MBDA Future Local Area Air Defence System (FLAADS-L) and Kongsberg National Advanced Surface-to-Air Missile System (NASAMS).

Electronic warriors

As well as training and weapons trials, Vidsel is well equipped with electronic warfare (EW) equipment for threat simulation. The size and location of the range makes it possible to use most EW systems and Vidsel can provide generic and real-world threat systems, as well as simulators/stimulators. Among the real hardware used are the Soviet-era SA-6 *Gainful* and SA-8 *Gecko* self-propelled surface-to-air missiles. Examples of generic equipment include the range instrumentation radar (RIR) and Mallina simulators, the latter an LED-based tool that stimulates an aircraft's ultraviolet (UV) missile warning system. Meanwhile, the Tracke is an adapted PS-46 fighter radar (taken from the Saab Viggen), which is available as a container-based system used to simulate a potential radar-emitting threat. Another key asset is the Golden Eye, a container-based generic stimulator used to test aircraft EW systems,

Meteor at Vidsel

The Vidsel Test Range played an important role in the effort to field the Meteor BVRAAM, with development and integration firings conducted at the range using Gripen fighters. In January 2006 a range work-up was conducted at Vidsel. This verified system communications and the set-up between the aircraft and the test range in advance of the first firing. The initial air launch demonstration (ALD) firing took place in May 2006 from a Gripen flying at an altitude of 22,966ft (7,000m).

The first trial of a flight-standard functional seeker was carried out in June 2006, with a seeker data gathering (SDG) missile carried under the wing of a Gripen. The SDG missile has no propulsion section or warhead but contains operational missile sub-systems and telemetry equipment. This test allowed data to be gathered over a variety of different flight conditions. Finally, in 2010, a first Meteor live-firing was conducted within the Swedish integration programme.

***The first Gripen E prototype, aircraft 39-8, carries a pair of Meteor BVRAAMs below the wings.** Saab*

Right: Air and ground forces take part in a joint exercise at Vidsel. In the past, the facility has hosted the live flying phase of the European Defence Agency's Helicopter Tactics Instructors Course (HTIC). Below: Among the target drones available at Vidsel is the Mach 0.93-capable BQM-167i, that can manoeuvre at up to 9g. This drone supports various missions by carrying different towed targets, as well as internal- and wing-tip-mounted payloads.

and which can be guided by the Tracke radar.

Typical aircraft missions include a combat readiness course including combat search and rescue (CSAR) in a contested environment, and sorties flown in an area defended by simulated ground-based threats against which the aircraft can release countermeasures (chaff and flares). Weapons release and EW environments can be combined, with aircraft conducting weapon delivery (including against moving targets) while jamming systems deny the GPS network.

Using the range's various EW assets, the GPS signal can be denied across the mission profile, jamming the aircraft before it takes off, during flight and as it releases its weapons. An FMV spokesperson confirmed to *AFM* that: "The range size and location makes it possible to provide very realistic [GPS jamming] scenarios."

The missile approach warning systems on board aircraft can be put to the test using the range's UV/infrared simulators. For this type of assessment, the UV/IR simulator could be installed on a location representative for an IR-threat-based weapon. When the aircraft flies over, the UV/IR system locks on to it and stimulates the aircraft's countermeasure system that might release flares.

Within Sweden, the Vidsel Test Range is designated as the organisation responsible for maintaining contact and dialogue with similar EW facilities at Polygone on the border between Germany and France and RAF Spadeadam in Cumbria. Both these foreign organisations will typically provide additional real and simulated air defence threats during the Arctic Challenge Exercise. While the FMV has run trials with the Vidsel range networked with other ranges in Sweden – allowing for tests be run simultaneously at different locations – this has not yet been implemented.

The EW systems at Vidsel are just part of the testers' repertoire – equally important are the various monitoring technologies used to gather data and then process it. The Vidsel Test Range is built for high-accuracy evaluation of trajectory and impact of high-speed weapon systems. This is supported by having high-precision optical and radar tracking systems covering the entire test range. Fixed and remotely controlled ground and aerial targets together can also be combined with possible EW threats to provide more realistic scenarios.

In addition to EW capabilities, radar cross-section (RCS) also involves critical data and measurements can be conducted on the range for a host of test articles, including aircraft, missiles and decoys. RCS is measured by mounting the object on a stand that can be radiated from all directions in different frequency ranges. It's also possible to take measurements of airborne objects using tracking radar.

Depending on the type of data being gathered, most information relating to tracking (or RCS) can be evaluated on site and does not need to be sent elsewhere for analysis. This provides for a more secure testing environment, ensuring the required level of security is maintained. The FMV spokesperson confirmed that the size and location of the range are other important factors in ensuring the required level of security – helping keep sensitive data hidden from 'prying eyes.' AFM

A Hungarian Air Force Gripen takes part in a live-firing exercise at Vidsel in 2015. Hungarian jets were back at Vidsel in 2018, practising with live AIM-9L Sidewinder and AGM-65 Maverick missiles, as well as GBU-12 laser-guided and Mk82 dumb bombs and 27mm cannon ammunition.

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Inadvertent passenger ejection from French Rafale – report released

AN OFFICIAL study has been published into the previously reported incident during which a civilian back-seater was accidentally ejected from an Armée de l'Air (French Air Force) Rafale B during a training mission from Base Aérienne 113 (BA 113) Saint-Dizier on March 20 last year (see *Attrition*, June 2019, p89). France's Bureau enquêtes accidents pour la sécurité de l'aéronautique d'État (BEA-É, Office of Accident Investigation for State Safety) released the report on April 6. It identifies the aircraft involved as serial 358 '4-FY' operated by Escadron de Transformation Rafale (ETR) 3/4 'Aquitaine'.

The civilian passenger was a 64-year-old employee of a French defence contractor. This was his first experience on an aircraft other than an airliner, the flight having been organised for him as a surprise by his colleagues. Because of the unexpected nature of the flight, he only underwent the required medical examination four hours beforehand, rather than the stipulated ten days. Although he was declared fit for the flight, the doctor said he should not be submitted to a negative load factor – information not received by the pilot or passenger.

After a walkaround of the aircraft, the passenger was installed in the rear seat, with the pilot having responsibility for adjusting the various restraint straps on his seat. In fact, the passenger carried out most of his installation into the cockpit by himself. This resulted in his visor being up, his anti-g trousers not being worn properly, his helmet and oxygen mask both being unattached and his seat straps not tight enough.

At 1250hrs local time on March 20, 2019, a patrol of three Rafales took off from runway 29 at BA 113 for a training mission, getting airborne with a 30-second delay between each, the incident aircraft being the last of the three. After take-off, the pilot retracted the undercarriage, accelerated and began a steep ascent with an attitude of 47° – which causes a load factor close to 4g – followed by a levelling out resulting in a load factor close to -0.6g. Passenger ejection took place during this manoeuvre. The pilot was not ejected and remained in control of the aircraft. Although confronted with this completely abnormal situation (non-ejection of the front seat, detached canopy, etc), he was able to put the aircraft safely back on the runway. He then exited the aircraft without assistance.

Both pilot and passenger received only minor injuries. The pilot suffered from slight contusions on the face. The ejected passenger was evacuated to Saint-Dizier hospital. His face showed traces of the pyrotechnic powder residue from the glass-cutting cord. The aircraft had lost its transparent canopy surfaces and also showed traces of powder residue. The canopy frame was deformed, and the rear seat demister lines had broken.

The aircraft was at a height of 650ft (198m) and speed of 280kts at the time of ejection. The rear-seat ejection sequence was initiated by activating the eject handle. The cutting of the two half-canopies (rear and front) took place correctly. The passenger lost his helmet and mask during the ejection, but the seat separation was effective. Release of the survival package took place automatically. However, the single-seat inflatable boat did not inflate. The descent under a stable parachute lasted one minute and four seconds and he landed beside the runway at low vertical speed.

The pilot remained on board, the automatic command ejection sequence having been interrupted in the final phase when the main pyrotechnic cartridge that should have fired his ejection seat did not work, enabling him to continue flying the aircraft and land safely. The explosion from the initial rear-seat ejection had ruptured the casing of the sequence selector that was supposed to trigger the pilot's seat, meaning the technical malfunction saved the aircraft. After touching down and stopping the jet on the taxiway, the pilot cut the engines. Fearing an untimely ejection, he evacuated the fighter very carefully without deactivating the seat and without outside assistance. With the seat not having been secured a safety perimeter was established around the aircraft until the task was completed 24 hours later.

The report noted that the passenger was nervous even before getting on board the aircraft and was not prepared for the precise conditions of take-off. He was therefore surprised by the load factor and its rapid reversal. Thus, the already extreme stress of the passenger and the unexpected passage into a negative load factor caused him to grip the ejection handle and resulted in its activation. The passenger's involuntary action on the handle was linked to a lack of understanding and preparation for certain effects inherent in fighter jet flight.

In a press release on April 20, Martin-Baker noted that although the Rafale is equipped with its MkF16F ejection seat, supplied by SMB in France, the inter-seat system that failed to fire the front seat is not supplied by either contractor and therefore it cannot comment on why the failure occurred. The company noted that the MkF16F ejection seat has had a 100% success rate ever since the first ejection in 2008. Judicial and defence investigations into the incident were continuing as *AFM* went to press.

Below: ***French Air Force Rafale B 358 '4-FY' from ETR 3/4 minus its canopy on the runway at Saint-Dizier following the inadvertent ejection of its back-seat passenger on March 20, 2019.*** *BEA-É*

Accident Reports

D: Mar 25
N/U: Russian Aerospace Forces/192 UAvB
T: L-39C Albatros

A student pilot from the Krasnodar Military Aviation College of Pilots was killed when this aircraft crashed at 1600hrs Moscow time near the village of Dmitrievskaya, during a training flight in the Krasnodar territory. The aircraft was from the school's Tikhoretsk branch.

D: Mar 25
N: Russian Aerospace Forces
T: Su-27

While on a routine training flight, this aircraft crashed into the Black Sea, 27nm from the town of Feodosia on the Crimea peninsula. The Russian defence ministry reported that the fighter disappeared from radar screens at 2010hrs local time and a distress signal from its emergency locator transmitter was recorded in the area at 2011hrs. A rescue operation was immediately launched, initially with an An-26 aircraft and Mi-8 helicopter assigned to the Southern Military District's search and rescue service, along with a Russian Navy frigate and several commercial ships. But the search for the pilot was hampered by bad weather and he was later found dead.

D: Mar 30
N/U: Chinese People's Liberation Army Ground Force/Hong Kong Garrison
T: Z-9ZH
S: 6202 (c/n Z9-0539)

This helicopter was destroyed when it crashed in rugged, mountainous, forested terrain during the late afternoon after hitting an electricity transmission tower during a training flight in heavy fog. The incident occurred in the area of Tai Lam Country Park while the helicopter was operating from the Hong Kong Garrison. The Hong Kong Security Bureau confirmed it had been notified of the accident by the garrison and the Chinese had said that no one had been injured on the ground and no property damaged. However, it was later reported that the four members of the crew had perished. This was the first accident in Hong Kong involving a PLA helicopter since the Chinese took over the former British colony in 1997.

***Above:** USAF/75th FS A-10C 81-0995 'FT' following its emergency landing with the undercarriage retracted at Moody AFB on April 7. USAF/Andrea Jenkins*

D: Mar 31
N: Libyan National Army
T: L-39 Albatros

Five personnel on the ground were killed and this aircraft was claimed to have been put out of service when it was hit during an air strike on al-Watiya air base by the Libyan Government of National Accord's forces. An ammunition dump at the base was also destroyed during the attack.

D: Apr 2
T: Libyan Government of National Accord
T: L-39 Albatros

According to an announcement by the Libyan National Army (LNA), this L-39 was shot down at around 1200hrs local time by LNA defence forces over al-Washka, south of Abu Qurain and west of Sirte. Although the LNA claimed that both the pilot and co-pilot were killed, some reports said they ejected safely and returned unharmed to the air force academy at Misrata. They were identified as Colonel Abdulnabi al-Areeq and Lieutenant Ibrahim Faraj.

D: Apr 5
N: Libyan National Army
T: An-32

Libya's Government of National Accord said it shot down this aircraft south of Tripoli, as it was landing at an airstrip near Tarhuna, Libya, because it was carrying ammunition for Libyan National Army (LNA) militias. The LNA confirmed the attack but disputed the claim that it was carrying ammunition and said the cargo was medical supplies for a field hospital set up to fight the coronavirus outbreak in Tarhuna. An unconfirmed report stated that it was hit by a weapon fired from a Bayraktar TB2 armed UAV.

D: Apr 7
N/U: Malian Republic Air Force/Escadrille de Chasse
T: A-29B Super Tucano
S: TZ-04C

Both crew members were killed when the pilot lost control, for unknown reasons, before this aircraft crashed at approximately 1125hrs local time while on approach to Base Aérienne 102/Camp Sévaré, Mopti/Ambodédjo-Barbe International Airport. An amateur video of the last few moments of flight shows the A-29B inverted at low altitude before the pilot manages to roll the aircraft upright, but with a high rate of descent, resulting in subsequent high-speed impact in a level attitude, causing it to immediately explode in a fireball. The aircraft is normally based at Base Aérienne 101, Bamako-Sénou International Airport. In a press briefing, the chief of the air staff identified the two crew lost as Capitaine Moussa Maïga and Sous-Lieutenant Mamadou Boubacar Traoré. The chief said the Super Tucano had been undertaking a zone reconnaissance mission in Sector 3 of Timbuktu with a second A-29B, TZ-02C, after which they returned to Sévaré in close formation without incident until control of TZ-04C was lost while manoeuvring to land.

D: Apr 7
N/U: US Air Force/23rd Wing/75th Fighter Squadron
T: A-10C Thunderbolt II
S: 81-0995 'FT'

During a routine training mission, the pilot declared an in-flight emergency and returned to Moody Air Force Base, Georgia, where the aircraft was landed with undercarriage retracted. The pilot was not injured but underwent a precautionary examination by flight surgeons before being released. There did not appear to be any major damage to the aircraft.

D: Apr 10
N: Private military contractor
T: SA341 Gazelle
S: ZU-ROJ

In the early hours of the morning, this aircraft was being flown on behalf of the Mozambique Army in support of operations against Islamic insurgents in the area

***Recovery operations under way to remove Ukrainian Air Force/204 BrTA MiG-29 '47 Blue' from the runway at Melitopol air base on April 11, the day after its landing accident.** Ukraine State Bureau of Investigation*

Abbreviations: **D:** Date **N/U:** Nationality/Units **T:** Type **S:** Serials

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of the Quirimbas Islands, north of Pemba, in northern Mozambique. But the helicopter's gearbox was reportedly badly damaged after it was suspected to have been hit by enemy ground fire. The Gazelle was one of two tasked to fly police officers from Pemba to a meeting at a local village on a small island approximately 30 minutes' flying time from the city. The pilot noticed the controls becoming increasingly stiff until it reached the point where it was becoming very difficult to fly, so he radioed the other Gazelle and said he was going to make a precautionary landing. The helicopter was put down safely in a football field in a small village about halfway back to Pemba. The second Gazelle landed alongside, and the pilot and passengers transferred to it from ZU-ROJ and were flown safely back to Pemba, where an engineer and two police officers, providing security, were embarked to return and repair the helicopter. However, on return to the emergency landing site, black smoke was observed and ZU-ROJ was found to be burning, with many people on the ground nearby. It was deemed almost certainly unsafe to land and the second Gazelle returned to Pemba while ZU-ROJ was abandoned. The helicopter was one of two South African-registered Gazelles being flown on behalf of the Mozambique Army during April, allegedly by the South Africa-based Dyck Advisory Group. The example lost, ZU-ROJ (c/n WA1987, ex G-CIEX, ZB682), was a former UK Army Air Corps Gazelle AH1 which was first sold to a UK commercial buyer as G-CIEX and then, after overhaul in Hungary, registered in South Africa last December 3. It wore an overall metallic dark blue scheme and had been operating in Mozambique with a pintle-mounted 20mm cannon in the cabin doorway. The identity of the other has not yet been reported.

D: Apr 10
N/U: Ukrainian Air Force/ 204 BrTA
T: MiG-29
S: '47 Blue'

At approximately 2100hrs local time, this aircraft sustained considerable damage during landing at Melitopol air base. The pilot was unhurt. A press release from Ukraine's State Bureau of Investigation said there had been a violation of flight rules which, under Article 416 of the country's criminal code, could result in a prison sentence of between five and 15 years for the pilot. Pre-trial investigations are under way with procedural guidance for the criminal investigation being provided by the prosecutor's office of the Zaporizhia Garrison of the Southern Region. Although no further details were given, a post-accident image released by the State Bureau of Investigation showed that the main undercarriage wheels had been torn off and were in the middle of a field, while another photograph showed two long furrows in the field, consistent with the aircraft's undercarriage having hit the ground before reaching the runway. It is reported that the aircraft collided with a tree on approach, causing considerable damage to the port wing and resulting in it touching down short of the airfield before finally coming to rest on its belly on the runway. The aircraft was from the 204 brihada taktichnoyi aviatsiyi (204 BrTA, 204th Tactical Aviation Brigade) at Lutsk, but had been detached to Melitopol for a regularly scheduled night-time training flight.

Pakistan Army MFI-17 Mushshak 83-5120 following its crash on April 13. *via Waseem Abbas*

D: Apr 12
N: Libyan National Army
T: Mi-35

Armed forces of the Government of National Accord (GNA) reportedly shot down this helicopter gunship over the town of Abu Qurayn, 85 miles (138km) west of Sirte, northern Libya, in an area bordering regions controlled by GNA and Libyan National Army (LNA) forces. All three crew members (Captain al-Senoussi al-Dorsi, 1st Lt Adel al-Zawwi and flight engineer Juma al-Obaidi) were killed. LNA personnel confirmed that the Mi-35 had crashed, but not that it had been shot down. Unconfirmed reports indicate a Turkish-made Aselsan/Roketsan HİSAR surface-to-air missile system was used to bring it down.

D: Apr 13
N/U: Pakistan Army Aviation Corps/Army Aviation School/303rd Army Aviation Group
T: MFI-17 Mushshak
S: 83-5120

During a routine training flight, this aircraft was destroyed when it crashed in an open field on the outskirts of Jalalpur Jattan city, in the Gujrat district of Punjab province. Both crew members, instructor Major Umer and student pilot Lieutenant Faizan, were killed. The aircraft was from the army aviation school at Rahwali.

D: Apr 15
N/U: French Army Air Corps/5e RHC/Escadrille d'Hélicoptères de Manoeuvre 3 'Grizzly'
T: AS532UL Cougar

This helicopter crashed at approximately 1630hrs local time at Bouilh-Devant, north of Tarbes, Hautes-Pyrénées, while undertaking a routine training exercise. Two 5e RHC crew members (Adjudant-Chef Olivier Michel and Brigadier Vincent Monguillon) were killed and the other five occupants injured, two of them seriously. One of the latter suffered serious burns and was taken to hospital in Toulouse.

D: Apr 16
N: Kazakhstan Air Defence Force
T: MiG-31
S: '04 Red'

Shortly after take-off for a routine combat training flight from the 610th Air Base at Karaganda, the aircraft had a fire in one of its engines. After being ordered to eject, the crew directed the aircraft towards an open field to avoid any

Indian Air Force AH-64E Apache ZV-4813 following its emergency landing on April 17.

Abbreviations: **D:** Date **N/U:** Nationality/Units **T:** Type **S:** Serials

casualties on the ground and then ejected safely. The MiG-31 came down to the south of the airfield.

D: Apr 17
N/U: Chadian Air Force/ Escadrille d'Appui
T: Su-25

While still stationary on the ramp preparing to taxi out for take-off from Base Aérienne N'Djamena/ Sergent Chef Adji Kosseï air base, the aircraft accidentally launched a rocket from under the port wing. After leaving the launch rail, the weapon was heading directly towards a French Air Force C-130H on the ramp opposite. However, in front of the Su-25 was an empty French Army fuel bowser and the rocket passed straight through it, deflecting it away from the Hercules. The rocket destroyed a private residence in the adjacent Farcha Garan Goso quarter, killing five occupants, including three children, while injuring three other civilians.

D: Apr 17
N/U: Indian Air Force/125 Helicopter Squadron 'Gladiators'
T: AH-64E Apache
S: ZV-4813

About one hour into a routine training sortie from its base at Pathankot Air Force Station, this helicopter had an indication of a critical instrument failure, forcing the crew to make an emergency landing. The crew were able to put the Apache down safely in an open field near Budhawar village, in the Hoshiarpur district of Punjab state, without injury to the pilots or any damage to the helicopter. An official Indian Air Force statement said the AH-64E was expected to be recovered following necessary repairs on site.

D: Apr 19
N: Turkish Air Force
T: Anka-S

This UAV, operating from the Libyan Government of National Accord base at Misrata, was destroyed when it burnt out after crashing following a shoot-down by Libyan National Army forces over Abu Qurayn, al-Washka, southeast of Misrata, Libya, using a Pantsir-S1E surface-to-air missile system.

D: Apr 22
N: Islamic Republic of Iran Police Aviation
T: Cessna T206H Turbo Stationair II
S: 1136

Fire damage to the Indian Air Force HAL Dornier 228-201 following a burst tyre and aborted take-off at Palam Air Force Station on April 30.

Both crew members were killed when this aircraft crashed into trees on the edge of the Motel Ghoo forest in northern Mazandaran province. The crash occurred in bad weather while the aircraft was en route to Tehran. Both victims were police officers.

D: Apr 23
N: US Army
T: MQ-1C Gray Eagle
S: 02197

This UAV was destroyed when it crashed at around 2100hrs local time in Niger, on the Tahoua road, not far from the village of Aghlal'ingharen, 22 miles (35km) from the city of Agadez. The crash site was initially secured by the local gendarmerie, who returned the following day with US personnel to remove weapons and sensitive equipment before destroying the remains. The UAV was operating from Agadez. This was the second Gray Eagle loss in Niger in the space of two months, one having also been lost on February 29 (see *Attrition*, May, p88).

D: Apr 29
N/U: Royal Canadian Air Force/12 Wing
T: CH-148 Cyclone
S: 148822

Contact with this helicopter was lost at around 2015hrs local time when it was operating from the Royal Canadian Navy Halifax-class frigate HMCS *Fredericton* (FFH 337) while on a routine flight as part of Operation Reassurance. The helicopter had been participating in exercises with Italian and Turkish naval partners as part of Standing NATO Maritime Group 2 in the Mediterranean Sea off the coast of Greece. Following a search-and-rescue operation, wreckage was found in the Ionian Sea about 45nm west of the island of Kefalonia and 20nm outside Greek territorial waters. The body of one of the six crew members, Master Corporal Matthew Cousins, was found soon after the crash, but the other five were missing as *AFM* went to press. On the following day, the RCAF formally named all six crew members, the other five being Sub-Lieutenant Abigail Cowbrough, Captain Kevin Hagen, Captain Brenden Ian MacDonald, Captain Maxime Miron-Morin and Sub-Lieutenant Matthew Pyke.

The still-burning wreckage of Bolivian Air Force Beechcraft 95-B55 Baron FAB-051 following its crash near Trinidad on May 2.

D: Apr 30
N/U: Indian Air Force/41 (Logistics Air Support) Squadron 'Otters'
T: HAL Dornier 228-201

This aircraft aborted take-off for a routine flight from Palam Air Force Station, Delhi-Indira Gandhi International Airport following a sudden deflation of the port mainwheel tyre. Although the Dornier came safely to a halt on the runway without injury to the crew, a fire erupted in the starboard main undercarriage. This resulted in extensive structural and fire damage to the undercarriage sponson, together with scorching of the adjacent fuselage area. Following the incident, an Indian Air Force technical team towed the aircraft clear of the runway to enable normal operations to resume.

D: May 2
N: Bolivian Air Force
T: Beechcraft 95-B55 Baron
S: FAB-051

About 12 minutes after take-off from Trinidad-Teniente Jorge Henrich Arauz Airport, Trinidad, for a flight to Viru Viru International Airport, Santa Cruz de la Sierra, the pilot reported a loss of engine power. He attempted to return to Trinidad, but crashed at 1342hrs local time into swampy terrain near Laguna Suárez, 6 miles (10km) from Trinidad. The two Bolivian Air Force pilots and four Spanish passengers were killed and the aircraft was destroyed by a post-crash fire. The aircraft was taking the passengers for repatriation and also carried samples from suspected COVID-19 patients in Trinidad for testing.

Additional material from: Waseem Abbas, Donny Chan, Igor Bozinovski, Scramble/ Dutch Aviation Society, Vladimir Trendafilovski, René L Uijthoven and Asagiri Yohko. AFM

Above:** On finals to Yuma last March 13, this is F-5N 761572 'LS-07' (c/n L1047, ex J-3047) that wears the unit's striking 'Snake' splinter pattern of sand, green and brown. Leading-edge root extensions and flattened 'shark' nose make the F-5N less likely to depart from controlled flight.* Matt Mansell ***Below: Lt Col William Sheridan leads an F-5N formation over Yuma in July 2016. As of last November, the 'Snipers' had around 15 pilots on strength, a reduction from the regular complement of approximately 20. USMC/Cpl Conner Robbins

Three US air arms each operate at least one flying unit specialising in the Red Air mission – known as aggressors to the US Air Force, and adversaries to the US Navy and US Marine Corps (USMC). These are the squadrons tasked with providing advanced air combat training, through both academics and flying activity, with the aim of developing the professional capabilities of frontline units.

Besides the more numerous Red Air units of the USAF and US Navy, the USMC activated a unit of this kind on March 18, 1986, when Marine Fighter Training Squadron 401 (VMFT-401) 'Snipers' was established at Marine Corps Air Station (MCAS) Yuma, Arizona. The squadron received its aircraft from June 1987, initially 13 Israeli-made Kfir fighters leased from Israel Aircraft Industries (IAI); under the US designation system, they became F-21A Lions. The aircraft was very well suited to the adversary role, boasting high-end performance to simulate all Soviet in-production fighters. Furthermore, since it wasn't in US military service, it fulfilled the 'dissimilar' criteria, which calls for aircraft different in appearance to frontline fighters.

Lions to Tigers

The F-21As were returned to Israel in 1989, and the 'Snipers' transitioned to a new mount, the single-seat F-5E Tiger II (and two-seat F-5F), receiving secondhand USAF aircraft. Although less powerful than the Lion, the Tiger was supersonic, agile, radar-equipped, of simple construction and inexpensive to support. With the end of the useful life of the F-5E/F fleet, in 2000 the US Navy began to study options for a successor. In February 2003, the navy signed a contract with Switzerland for the acquisition of 30 F-5Es considered surplus by the Swiss Air Force, at a cost of US$26.5m. These aircraft were in excellent condition and had low flying hours – on average, around 1,800 per airframe.

The ex-Swiss F-5Es are slightly different compared with the US examples, featuring an LN-33 inertial navigation system (INS), AN/ALR-87 radar warning receiver (RWR) and AN/ALE-40 chaff and flare system. In terms of aerodynamics, they have a more 'sharpened' radome, extended leading-edge roots, plus automatic manoeuvre slats and flaps. At a cost of around US$24m, the aircraft were reworked at Northrop Grumman's plant in St Augustine, Florida, beginning in 2003, to become compliant with US Navy standards. In the process, they received a tactical air navigation (TACAN) system, AN/ALQ-167 electronic countermeasures (but not on all aircraft) and an engine performance assurance monitoring system (EPAMS). A new AN/APG-

Tiger kings

AFM had the opportunity to visit VMFT-401 'Snipers,' an adversary squadron that's part of the US Marine Corps Reserve, reporting to Marine Aircraft Group 41. ***Riccardo Niccoli*** *reports from Marine Corps Air Station Yuma, Arizona.*

69 radar was also added in place of the previous AN/APQ-159V(3). The F-5s had their 20mm cannon removed and were equipped with AN/ASQ-50 Tactical Combat Training System (TCTS) pods, which collect all flight data and transmit them to the ground, providing a complete mission picture for debriefing.

Deliveries of modified aircraft were completed by 2007 and they were re-designated F-5N, before being assigned to two adversary squadrons: the US Navy's Fighter Squadron Composite 13 (VFC-13) (see *Fighting 'Saints'*, January 2018, p46-51) and the USMC's VMFT-401.

The first F-5Ns for the 'Snipers' arrived at Yuma at the end of 2005. The previous year, the navy had decided to activate a third adversary squadron, VFC-111 at Naval Air Station (NAS) Key West, Florida, and a new contract for an additional 12 Tigers was signed with Switzerland, bringing the total fleet to 44. During the upgrade process, four of these aircraft were converted into two-seaters, replacing the existing aft fuselage sections with examples from four older F-5Fs. After this work, these aircraft were dubbed 'Franken-Tigers.'

The last of the 44 modified ex-Swiss aircraft was delivered in June 2008. Subsequently, the LN-33 INS was replaced with the more modern LN-260. Under original US Navy plans, these aircraft were to be decommissioned in 2015, but the Tigers remain in service, thanks to a programme that has extended airframe life up to 8,000 hours. This included the replacement of the cockpit superior longerons, wings and tail surfaces. The F-5 remains a suitable aircraft for the Red Air mission, although its ability to replicate the most modern frontline fighters flown by potential enemies is somewhat limited.

Traditions and attributes

As adversaries, the VMFT-401 aircraft are painted in special camouflage schemes to simulate the aircraft of potential non-friendly air forces. Four colour schemes are in use: 'Ghost' (shades of grey and light blue), 'Snake' (sand, green and brown splinter pattern), 'Lizard' (shades of sand and brown) and 'Patches' (patches of four different shades of blue and light blue). Since 2014, the squadron has been assigned the 'LS' tailcode – meaning 'Lucky Snipers.' It is worn on the fin below the squadron badge, which is a red star. Reflecting the traditions of the adversary role, the squadron rooms feature inscriptions and mottos in Russian Cyrillic, and the pilots' nicknames, worn on their flying suits, are also in Cyrillic. On the nose of the aircraft are individual numeric codes in the style of Russian 'Bort' numbers.

***Above:** The cockpit of the non-upgraded F-5N would be familiar to most Western pilots of Cold War vintage and is now set for an upgrade. The single small multifunctional display seen here was added at St Augustine after the jets arrived from Switzerland.* *All photos Riccardo Niccoli unless stated*

Becoming an adversary

At MCAS Yuma, *AFM* met Maj David Haas, VMFT-401's pilot training officer and previously an F/A-18 aviator with Marine Fighter Attack Squadron 115 (VMFA-115) at MCAS Beaufort, South Carolina. He explained about the training required become an adversary pilot in the USMC: "The candidates are all volunteers and must, of course, come from one of the fighter fleets. In addition, they have to have completed at least one tour with the fleet, to have gained qualifications as an instructor and in combat tactics, and they have to have taken part in combat training courses at NAS Fallon [in Nevada] and with MAWTS-1 [Marine Aviation Weapons and Tactics Squadron One] at Yuma. They must have at least 1,000 flying hours and are, in practice, senior pilots, nearly always with the rank of major. The candidates are examined by a board, to best evaluate them. Assignments are not on a regular basis – sometimes we have two or three new pilots per year, sometimes none."

At the time of *AFM*'s visit, the 'Snipers' had around 15 pilots, divided almost equally between active-duty officers and reserve officers, but the standard complement is approximately 20. The path to becoming an adversary starts with around six hours of ground school, using a computer-based training system. Then comes the flying component – two missions in the two-seat F-5F, and then in the single-seater, to become familiarised with the Arizona and California flying areas and ranges, and with Yuma airport procedures (the base has mixed military and civil traffic). Next is qualification in the all-weather intercept phase, followed by basic fighter manoeuvres (BFM), with 1-v-1 engagements, and then 1-v-1-v-1, to learn how to avoid dangerous situations when air-to-air missions involve multiple aircraft. Then there are 2-v-1 and 1-v-2 engagements, and activities become increasingly complex. The full course lasts around a year and another six months have to be added to reach the highest qualification – mission commander.

VMFT-401's mission is to teach the fleet in air-to-air combat, providing the best possible quality dissimilar air combat training (DACT). The 'Snipers' support USMC fighter squadrons with advanced combat training for all pilots, including the youngest who have only recently been assigned to the front line. VMFT-401's 'customers' are the operational squadrons flying the F-35, F/A-18 or AV-8B. These request specific features for each training session, identifying the degree of difficulty, level of aggression, as well as any particular aspects of combat that require focus.

Red Air in demand

Sometimes squadrons deploy to Yuma, while on other occasions the 'Snipers' redeploy to the various USMC air bases: for example, two weeks at MCAS Beaufort for combat training on behalf of the resident F-35B unit. Not surprisingly, the squadrons that get the most out of VMFT-401 are the two flying F-35Bs (VMFA-122 and 211) and the two operating the AV-8B/B+ (VMA-214 and 311) that are based at Yuma.

The squadron's most demanding commitments involve supporting the two fleet replacement squadrons serving the fighter fleets – Marine Fighter Attack Training Squadron 101 (VMFAT-101) for the Hornet line at MCAS Miramar, California, and VMFAT-501 for the F-35B at Beaufort – as well as participation in the Weapons and Tactics Instructor (WTI) courses. These latter are organised twice a year at Yuma by MAWTS-1. The WTI courses see participation by all USMC units, which carry out large-force exercises (LFE), with the participation of 40 or more aircraft in each mission. For these events, the 'Snipers' are requested to simulate specific threats, decided by the exercise directors, and sometimes develop new tactics

***Left:** F-5N 761527 'LS-02' (c/n L1002, ex J-3002) is in the three-tone grey/light blue scheme known as 'Ghost'. The F-5N is considered an excellent threat replicator, being small and hard to see, agile and able to simulate a multitude of threat aircraft.* Matt Mansell
***Right:** A 'Snipers' pilot runs through pre-flight checks in the cockpit of his F-5N, last November 20. Note the WTI patch – the Weapons and Tactics Instructor course large-force exercise is run twice a year at Yuma by the resident MAWTS-1. **Below:** The 'Franken-Tiger' in its lair. The first of these rebuilt two-seaters – F-5F 761586 'LS-00' (c/n L1061/1154, ex J-3061) – made its maiden flight on November 25, 2008 and was delivered to VMFT-401 the following December 9.*

***Above:** Touching down on the Yuma runway, this is F-5N 761546 'LS-04' (c/n L1021/1114, ex J-3021), wearing the two-tone brown and green scheme known as 'Lizard'. The 'Snipers' share the runway with civil traffic.*
***Below:** Another view of 'Lizard' jet F-5N 761546 'LS-04' on the Yuma ramp. Despite the limitations of the jet, the 'Snipers' use the F-5N to replicate threats ranging from the basic MiG-21 to the advanced Su-30, drawing upon the pilots' subject matter expertise.*

to provide the best threat simulation possible.

When committed to supporting the other squadrons, the 'Snipers' are extremely busy, each pilot sometimes flying two or three sorties daily. Since the F-5 lacks an inflight refuelling capability, each mission lasts an average of 30 to 45 minutes. Especially important are the briefings in which Red and Blue Air come together to discuss the mission. Usually, the Reds do not disclose information about their plans and the Blues don't know how many adversary aircraft they will face. The main rule is to comply fully with the stipulated rules of engagement, since safety is always the first concern.

Adversary training is not only limited to the flying: the 'Snipers' are also specialists in different aspects of air combat. For example, Maj Haas is an expert on infrared air-to-air missiles and the instructors also teach academics on behalf of the operational squadrons.

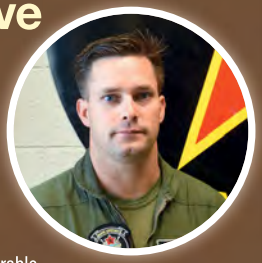
Maj Haas continued: "Each pilot in the 'Snipers' usually flies an average of between 200 and 300 hours per year, according to the various deployments that are scheduled." The advantage of flying at Yuma is the possibility of exploiting the various air ranges and training areas available in the southern Arizona and California regions. These start with the Yuma Proving Ground, located in the desert northeast of Yuma, only five minutes flying time from the base, and extend to the Chocolate Mountains and Twentynine Palms in California, and the expansive Barry M Goldwater range, in the desert between Yuma and Tucson, along the Mexican border.

Sustaining the 'Snipers'

The 'Snipers' operate 11 single-seat F-5Ns – plus one two-seat F-5F – and thanks to the aircraft's straightforward maintenance of the aircraft, they are able to record a high level of serviceability.

Under an outsourcing contract, maintenance

Impressive fighter



Maj David Haas, VMFT-401's pilot training officer, highlighted the F-5N's excellent air combat capability, despite the age of the platform: "The F-5 is still a very manoeuvrable fighter, is cheap to operate and still performs very well, even against the F/A-18 Hornets. The F-5s do not have sophisticated avionics systems and so it's the instructors that make the difference in the training." In terms of numbers, the F-5N boasts a maximum speed of Mach 1.6, can pull between +7.33 and –3.0g, has an impressive roll rate of 720° per second and an instantaneous turn rate of 17° per second at 15,000ft (4,572m).

Above: Maj David Haas, VMFT-401's pilot training officer, in the 'Snipers' squadron room at Yuma. The boss's background includes time as a 'legacy' F/A-18 pilot with Marine Fighter Attack Squadron 115 at MCAS Beaufort, South Carolina.

F-5N 761583 'LS-01' (c/n L1058, ex J-3058) in the two-tone blue/grey scheme known as 'Patches'. Each of the 'Snipers' pilots usually flies between 200 and 300 hours annually, a figure that fluctuates depending on the exercise calendar.

activities are assigned to the PAE (Pacific Architects and Engineers) company, which uses ex-military personnel to work on the aircraft. The contract, signed in 2016, includes logistic and technical support of all F-5s in service with the navy and USMC at Fallon, Key West and Yuma. In 2010, reflecting the Tiger's basic reliability, VMFT-401 was recognised by the Marine Corps commander for having flown more than 50,000 hours over 15 years without an accident. Considering the average length of a mission, this represented around 70,000 sorties without major incident – also strong evidence of the professionalism of the 'Snipers' pilots.

Today, the Tiger is the only US military Red Air aircraft that complies with the 'dissimilar' requirement, the other aggressors being F-16s and F/A-18s, as used in operational squadrons. During air combat training, many pilots have to face the same aircraft they fly. "Flying a different aircraft for sure helps; it is absolutely an advantage in terms of training," Maj Haas observed.

As to the future of the unit, the Pentagon included US$39.7m in Fiscal Year 2020 to buy 22 more F-5E/Fs from the Swiss Air Force, to replace or supplement the 43 F-5N/Fs now in use. The target is to keep the Tiger in service until 2030. The USMC has already declared it would like to acquire around 20 F-5Ns to deploy at three more bases in the US. At first, VMFT-401 would activate detachments at Miramar and Beaufort; later, a second adversary squadron would be established at Beaufort, with a detachment at MCAS Cherry Point, North Carolina, in order to satisfy the increasing demand for air-to-air combat training.

New focus on air combat

The Marines Corps fighter fleet – traditionally formed of Hornets and Harriers – has always been orientated towards providing support to ground forces. But today, with the introduction of the new F-35B/C and upgrading of some Hornets with active electronically scanned array (AESA) radars, the marines need to increase their training in the air-to-air arena, to exploit fully their aircraft's capabilities. VMFAT-501 alone has a requirement for more than 1,500 hours of adversary training annually; using F-35s for this task is a waste of resources. If the F-5s planned to be acquired are modernised with a new radar, infrared search and track (IRST) sensor, electronic countermeasures and helmet-mounted sight, they will be able to increase these air combat capabilities in the future.

That the F-5E is still considered a suitable platform for the job is evidenced by the fact that Tactical Air Support (TacAir), based at Reno, Nevada, purchased 21 Tiger IIs from Jordan in 2017, and has been modifying them at Northrop Grumman's facility since 2018, including the introduction of a glass cockpit. At the end of 2018, TacAir received a five-year US Navy contract worth US$107m to provide adversary training for the fighter fleets, plus electronic counter-countermeasures (ECCM) training for warships. At the same time, the US Navy is leveraging TacAir's F-5AT upgrade for its own Tigers. The jets began to receive new ejection seats last December and prototype conversions will bring an initial two aircraft up to a standard similar to the F-5AT, which features a Garmin large-area cockpit display, hands on throttle and stick (HOTAS) controls, radar warning receiver and a Nemesis mechanically scanned array radar. AFM

Above: Two jets in the 'Ghosts' scheme recover to Yuma in tight formation. These are F-5Ns 761527 'LS-02' (L1002, ex J-3002) – nearest camera – and 761579 'LS-09' (c/n L1054, ex J-3054).

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'One aircraft, one missile, one mission.' During this era of multi-role warplanes, the French Air Force's Groupe de Chasse 1/2 'Cigognes' is something of an anomaly in the NATO fighter community. Even within the Armée de l'Air, the unit's name differentiates it from others – this is proudly a 'fighter group' rather than the normal escadron (squadron). And the 'Cigognes' pilots are proud to fly the Mirage 2000-5F, using it exclusively in the air defence role.

Photo: Olivier Ravenel/Armée de l'Air
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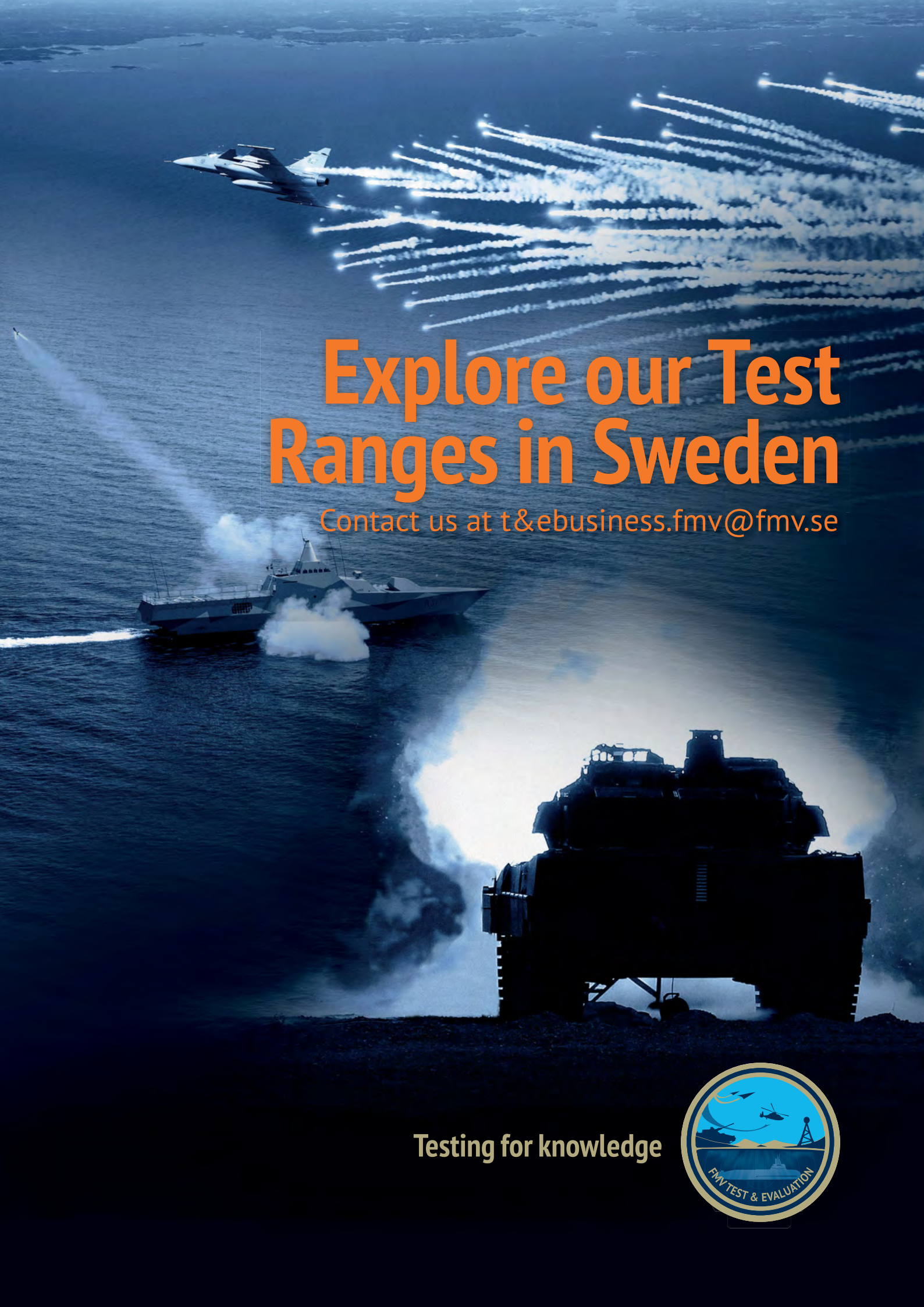
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